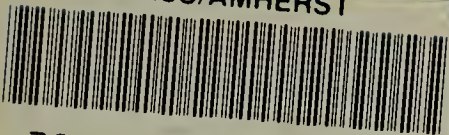


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Division of Air Quality Control

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL QUALITY ENGINEERING

DIVISION OF AIR QUALITY CONTROL

1981

AIR QUALITY DATA REPORT

ONE WINTER STREET - 8TH FLOOR
BOSTON, MASSACHUSETTS 02108

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COLLECTION

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I. INTRODUCTION

This report presents 1981 annual air quality data for Massachusetts collected by the Division of Air Quality Control within the Department of Environmental Quality Engineering. This data is collected by the Commonwealth and submitted to U.S. Environmental Protection Agency (EPA) in accordance with Regulations 40 CFR 58.

The Division of Air Quality Control (DAQC) has primary responsibility for measuring ambient air quality to verify compliance with state and national standards for ambient air quality (see Table 1), to support development of regulations designed to reduce ambient air contaminants, to assess the effectiveness of existing air pollution control strategies and to fulfill EPA reporting requirements for air quality data.

The continuous air monitoring stations are located in a variety of areas within Massachusetts, both urban and rural. The stations are equipped with air pollution monitoring equipment (see Table 4, equipment listing) and, in some cases, meteorological equipment. The air pollution monitors record levels of ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide and total suspended particulates. Meteorological parameters measured in most instances include wind speed, wind direction and temperature.

The Commonwealth's ambient air monitoring network is complemented by a private network of monitors. The private network - a result of Massachusetts allowing certain facilities to burn a higher sulfur content fuel than is otherwise allowed by Massachusetts air quality regulations - is limited to sulfur dioxide and particulate monitoring. Figures 2, 4, 7, 9, and 10 present the Commonwealth's monitoring network for each of the five pollutants, maintained by DAQC in 1981.

This year the Division collected a total of 295,776 hourly samples at the state operated sites and 545,923 hourly samples at the privately operated sites for a grand total of 841,699 (see Figure 1).

The figure represents an increase of 38,000 hourly samples over those collected in 1980. This data has been summarized herein as a matter of public record for information purposes. Data that had standard violations were recorded for the following pollutants; 8 hour carbon monoxide and ozone (see Table 2). For further information relative to the content of this report or other air quality related matters please contact either the Division of Air Quality Control in Boston or the regional office responsible for the particular area of concern.

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TABLE 1

NATIONAL AND MASSACHUSETTS AMBIENT AIR QUALITY STANDARDS

CONTAMINANT	TYPE OF AVERAGE & AVERAGING TIME	PRIMARY STANDARD	SECONDARY STANDARD
SULFUR DIOXIDE (SO ₂)	ANNUAL ARITHMETIC MEAN	80 ug/M ³ (0.03 ppm)	SAME
	*MAXIMUM 24 HOUR AVERAGE	365 ug/M ³ (0.14 ppm)	SAME
	*MAXIMUM 3 HOUR AVERAGE	NONE	1300 ug/M ³ (0.5 ppm)
TOTAL SUSPENDED PARTICULATES (TSP)	ANNUAL GEOMETRIC MEAN	75 ug/M ³	**60 ug/M ³
	*MAXIMUM 24 HOUR AVERAGE	260 ug/M ³	150 ug/M ³
CARBON MONOXIDE (CO)	*MAXIMUM 8 HOUR AVERAGE	10 mg/M ³ (9 ppm)	SAME
	MAXIMUM 1 HOUR AVERAGE	40 mg/M ³ (35 ppm)	SAME
PHOTOCHEMICAL OXIDANTS: MEASURED AS OZONE (O ₃)	*MAXIMUM 1 HOUR AVERAGE	235 ug/M ³ (0.12 ppm)	SAME
NITROGEN DIOXIDE (NO ₂)	ANNUAL ARITHMETIC MEAN	100 ug/M ³ (0.05 ppm)	SAME

* Not to be exceeded more than once per year.

** Annual average is considered as guideline.

ug/M³ - micrograms per cubic meter
 mg/M³ - milligrams per cubic meter
 ppm - parts per million

STATIONS EXCEEDING NATIONAL AMBIENT AIR QUALITY PRIMARY STANDARDS

POLLUTANT	LOCATION	AQCR	ADDRESS	SAROAD #	MONTH	DAY	TIME	LEVEL REACHED
SULFUR DIOXIDE (SO ₂) (Annual)								
NO VIOLATIONS RECORDED								
CARBON MONOXIDE (CO) (Eight hour average)	Spring-field	Pioneer Valley	1586 East Columbus Ave.	2160-007	Dec.	22		10
	Boston	Met. Boston	Kenmore Square	0240-002	Dec.	4	5 PM	14
					Dec.	29	2 PM	10
	Boston	Met. Boston	Essex Street	0240-022	Jan.	10	11 AM	12
					Jan.	23	9 AM	11
					Jan.	29	9 AM	10
					Jan.	31	8 PM	11
					Feb.	1	3 AM	10
					Apr.	23	11 PM	11
					June	4	6 PM	10
					June	20	7 PM	10
					July	6	1 PM	10
					July	10	1 PM	10
					July	11	5 PM	11
					July	30	6 PM	11
					Sep.	19	9 PM	11
					Sep.	26	12 PM	10
					Oct.	2	10 PM	10
					Oct.	16	9 AM	12
					Nov.	3	9 PM	10
					Nov.	16	5 PM	12
					Nov.	18	3 PM	10
					Dec.	1	5 PM	10
					Dec.	2	10 AM	12
					Dec.	3	10 AM	11
					Dec.	15	10 AM	13
					Dec.	22	8 PM	10

Somerville	Met. Boston	Powder House Blvd.	2100-003	Dec.	4	11 PM	10
E. Boston	Met. Boston	340 Breman St.	0240-021	Oct.	24	12 AM	10

NO VIOLATIONS OF THE ONE HOUR STANDARD RECORDED

NITROGEN DIOXIDE (NO₂)

NO VIOLATIONS RECORDED

OZONE (O ₃)	Agawam	Pioneer Valley	1615 Suffield St. (Tenn. Gas Pipeline Dist.)	0030-002	May	25	4 PM	.157 p
					May	30	5 PM	.195 p
					June	16	4 PM	.157 p
					June	21	7 PM	.125 p
					Aug.	9	7 PM	.125 p
					Aug.	11	2 PM	.125 p
					Aug.	15	2 PM	.135 p
	Attleboro	Southeastern	947 Park Street	0120-003	Sept.	14	4 PM	.125 p
	Charlton	Cent. Mass.	Bay Path Technical High	0372-001	May	25	4 PM	.130 p
	Easton	Met. Boston	300 Main Street	0535-001	May	30	7 PM	.160 p
	Hamilton	Met. Boston	Bld. #9 Sagamore Hill	0795-014	Aug.	11	2 PM	.130 p
					Sep.	14	4 PM	.137 p
					Aug.	3	2 PM	.134 p
					Aug.	4	1 PM	.132 p
	Sprgfield	Pioneer Valley	Fernbank St. and Boston Road	2160-014	May	25	4 PM	.137 p
					May	30	5 PM	.165 p
					June	16	5 PM	.143 p
					Aug.	11	2 PM	.125 p
	Ware	Pioneer Valley	Ware High School - Route 32	2360-001	May	25	5 PM	.165 p
					May	30	7 PM	.170 p
					June	16	6 PM	.162 p
					June	21	8 PM	.127 p
	Worcester	Cent. Mass.	Worcester Airport	2640-015	May	30	7/8 PM	.139 p
					June	16	6 PM	.130 p
	Worcester	Cent. Mass.	DPW Yard - Belmont Ave.	2640-019	June	16	6 PM	.125 p

HEALTH AND WELFARE EFFECTS OF AIR POLLUTANTS

POLLUTANTS AND THEIR SOURCES	HEALTH EFFECTS	WELFARE EFFECTS
<u>Ozone</u> Product of reactions of motor vehicle exhaust, industrial process emissions and other fossil fuel combustion emissions, in the presense of sunlight.	Causes difficulty in breathing, especially when exercising, irritates eyes, may result in an increased susceptibility to respiratory infection.	Toxic to plants by causing both leaf damage and a decrease in growth. Can weaken materials such as rubber and fabrics.
<u>Total Suspended Particulates</u> Fossil fuel burning, industrial process emissions, motor vehicle exhaust, traffic movement over dusty roads.	Causes further distress to those with chronic lung diseases, can alter the lungs natural cleansing mechanism and can either be composed of or have toxic materials adhered to the surface.	Causes soiling of materials, are corrosive and can damage buildings. In addition, causes haze which reduces visibility and the amount of solar energy reaching the earth.
<u>Carbon Monoxide</u> Internal combustion engines, fossil fuel combustion and cigarette smoking.	Reduces the blood's ability to carry oxygen which may cause heart and brain damage. Causes a decreased exercise capacity in those with angina pectoris. Also can cause slowed physical reactions, dizziness, fatigue and headache.	No known effect on materials or vegetation.
<u>Sulfur Dioxide</u> Combustion of fossil fuel	Irritation of throat and lungs and aggravation of symptoms among those with chronic lung diseases.	Corrosion and deterioration of metals, brittleness of paper, discoloration of paint and deterioration of fabric. Causes leaf damage to some plants.
<u>Nitrogen Dioxide</u> Emitted from motor vehicles and fossil fuel burning operations such as power plants as well as from chemical plants and refineries.	Aggravation of symptoms in those with asthma and chronic bronchitis an increased susceptibility to respiratory infections and a decrease in lung	Fading of dyes, yellowing of leaves on plants, and changing the horizon to a reddish brown color.

TABLE 4

ANALYSIS COLLECTION METHOD LISTING

Sulfur Dioxide:

- *14 instrumental coulometric
- 20 pulse fluorescent instrumental

Carbon Monoxide:

- 11 non-dispersive infra-red
instrumental

Ozone:

- 11 chemiluminescent
instrumental
- 12 ultra violet instrumental

Nitrogen Dioxide:

- 14 chemiluminescence
instrumental

Total Suspended Particulates

High volume air sampler

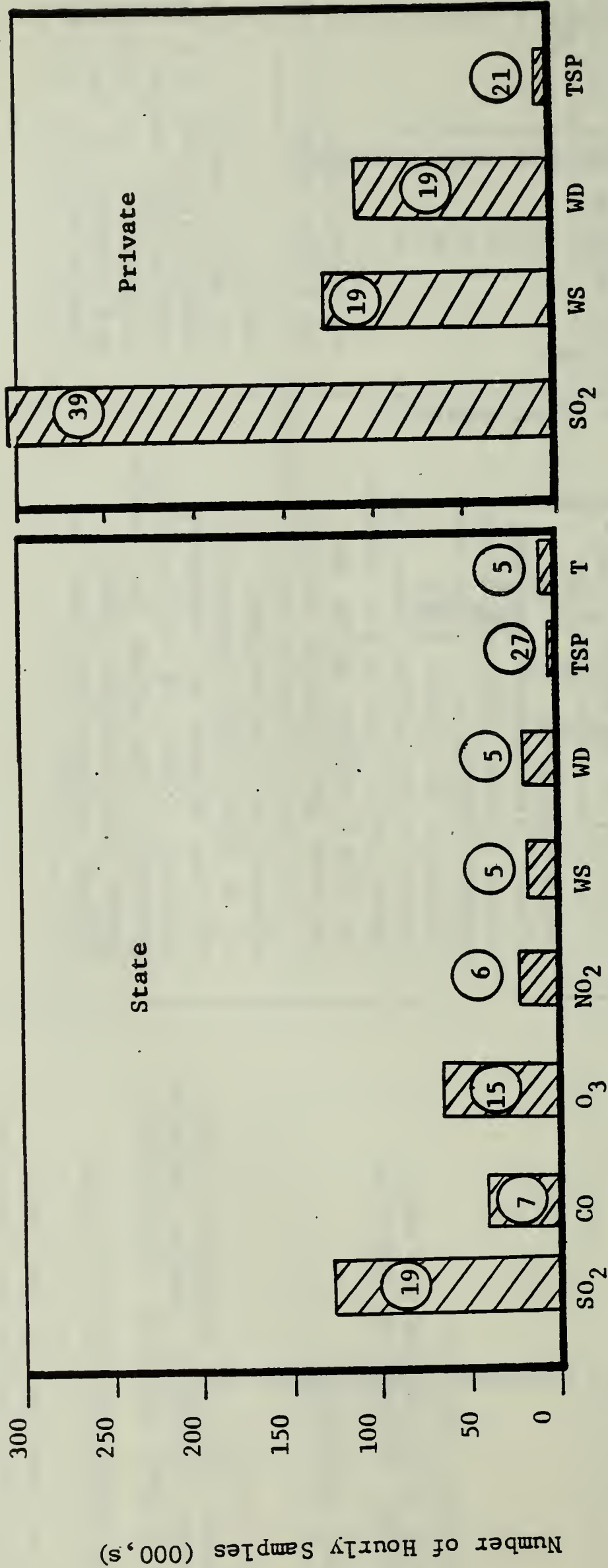
Methane/Total Hydrocarbons

Flame Ionization

* corresponds to data summary: instrument method

- 1981 -

GRAND TOTAL = 841,699 Hourly Samples



KEY

(xx) = Number of Sites

SO₂ = Sulfur Dioxide

CO = Carbon Monoxide

O₃ = Ozone

TSP = Total Suspended Particulates

T = Temperature

NO₂ = Nitrogen Dioxide

WS = Wind Speed

WD = Wind Direction

II. 1981 SITE DIRECTORY

LOCATION	SAROAD # DIST. #	UTM COORD. EAST NORTH	REC HGT (M)	STATION TYPE	POLLUTANTS SAMPLED				
					SO ₂	CO	O ₃	NO ₂	TSP
BERKSHIRE AIR QUALITY CONTROL REGION									
Worcester Alton Ave. (State Police Barracks)	1800-004	<u>646000</u> <u>4702700</u>	5	Center City- Industrial					X
Worcester East St. (Pittsfield Incinerator)	1800-005	<u>647923</u> <u>4701385</u>	11	Rural- Industrial	X		X		
Worcester Berkshire Commons (Roof of Berk- shire Commons)	1800-006	<u>643500</u> <u>4699897</u>	11	Center City Commercial					X
CENTRAL MASSACHUSETTS AIR QUALITY CONTROL REGION									
Worcester Way Path Tech- nical High	0372-001	<u>255600</u> <u>4668600</u>	10	Rural- Agricultural			X		
Fitchburg Summer St. Sub- station (Fitchburg Gas & Electric Co.)	0620-003	<u>271500</u> <u>4716800</u>	5	Center City- Industrial	X				
Fitchburg 55 Main St. (Fitchburg Gas & Electric Co.)	0620-006	<u>269900</u> <u>4718200</u>	11	Center City- Commercial					X
Worcester Wardner Airport (BTWN Hangars & 2)	0720-003	<u>254100</u> <u>4717700</u>	11	remote					X

II. 1981 SITE DIRECTORY

STATION LOCATION	SAROAD # DIST. #	UTM COORD. EAST NORTH	REC. HGT. (M)	STATION TYPE	POLLUTANTS SAMPLED				
					SO ₂	CO	O ₃	NO ₂	TS
Worcester River St. (Quaboag Reg. High School)	2372-001	<u>732000</u> 4677900	5	Rural- Agricultural					X
Worcester Boylston St. (Quinnsigamond Community College)	2640-011	<u>269600</u> 4688100	10	Center City- Commercial					X
Worcester Corner New Salem & Washington Sts. (near downtown Worcester)	2640-012	<u>269000</u> 4682100	4.5	Center City- Commercial	X	X	X	X	X
Worcester 419 Belmont St. (Worcester health dept., corner of Belmont St and Lake Ave.)	2640-013	<u>272400</u> 4683700	5	Center City Residential					X
Worcester Worcester Airport	2640-015	<u>262700</u> 4684000	5	Suburban- Residential			X		
Worcester 2 Washington St. (Worcester YMCA Bldg.)	2640-016	<u>269100</u> 4682200	13	Center City- Commercial					X
Worcester Central and Summer Sts. (Main Post Office)	2640-017	<u>296500</u> 4682800	8.2	Center City- Commercial	X				
Worcester Grove St. (VOC. TECH. SCH.)	2640-018	<u>269100</u> 4683750	10	Center City- Commercial					X

II. 1981 SITE DIRECTORY

LOCATION	SAROAD # DIST. #	UTM COORD. EAST NORTH	REC HGT (M)	STATION TYPE	POLLUTANTS SAMPLED				
					SO ₂	CO	O ₃	NO ₂	TSP
chester Belmont Ave. (DPW Yard)	2640-019	<u>272300</u> 4683800	4	Center City- Residential	X		X	X	

MERRIMACK VALLEY AIR QUALITY CONTROL REGION

Georgetown Georgetown High School Parking Lot	0730-001	<u>337300</u> 4731900	4	Suburban- Residential			X		
ence General St. Lawrence General Hospital)	1000-003	<u>324000</u> 4730500	23	Center City- Commercial	X				X
ence High St. (Storrow Pk.)	1000-005	<u>342220</u> 4730590	4	Center City- Residential	X		X		
ell 5 YMCA Drive	1080-006	<u>310370</u> 4722640	7	Center City- Commercial	X				X
ell Merrimack St. (Old City Hall)	1080-007	<u>310400</u> 4723800	5	Center City- Commercial	X				

METROPOLITAN BOSTON AIR QUALITY CONTROL REGION

ton 90 Commonwealth Ave. (Kenmore Sq Site)	0240-002	<u>327100</u> 4690400	4.5	Center City- Commercial	X	X		X	
ton Southampton St. (Fire Hdqts.)	0240-012	<u>329580</u> 4688230	14	Center City- Commercial					X
ton 8 Central Square	0240-013	<u>331903</u> 4693212	3	Center City- Residential					X

II. 1981 SITE DIRECTORY

SITE LOCATION	SAROAD # DIST. #	UTM COORD. EAST NORTH	REC HGT (M)	STATION TYPE	POLLUTANTS SAMPLED				
					SO ₂	CO	O ₃	NO ₂	TSP
ston Kneeland St. (State Parking Lot)	0240-015	<u>330000</u> 4690000	3	Center City- Commercial	X				
ston Visconti St., E. Boston (Callahan Tunnel)	0240-016	<u>332000</u> 4692500	5	Center City- Residential	X	X	X	X	
ston 340 Breman St., E. Boston (substation)	0240-021	<u>333000</u> 4693550	3	Center City- Residential	X	X	X	X	
ston 600 Washington St	0240-022	<u>330100</u> 4690750	3.3	Center City- Commercial		X			
ston Morrissey Blvd. (Savin Hill Yacht Club)	0240-023	<u>331500</u> 4686950	5	Center City Residential	X				
ston 200 Columbus Ave (fire station rooftop)	0240-024	<u>329400</u> 4690350	10	Center City- Commercial					X
ockton Crescent St., Rte. 27 (Paine School)	0320-003	<u>333300</u> 4660400	14	Center City- Industrial					X
elsea Chestnut and Sixth St.	0380-002	<u>332500</u> 4695100	16	Center City- Commercial					X

II. 1981 SITE DIRECTORY

LOCATION	SAROAD # DIST. #	UTM COORD. EAST NORTH	REC HGT (M)	STATION TYPE	POLLUTANTS SAMPLED				
					SO ₂	CO	O ₃	NO ₂	TSP
on 00 Main Street orth Easton (Post Office)	0535-001	327050 4659170	5	Rural- Near Urban			X		
lton ldg. 9, agamore Hill (Air Force Sta.)	0795-001	351150 4721200	13	Rural-Near Urban			X		
Field orth Meadow St. Rt. 27, Medfield (State Hospital)	1210-001	307200 4675800	24	Rural- Commercial	X		X		X
ord 00-200 Main St. (Fire Headqtrs.)	1220-002	326300 4697990	7	Center City- Commercial					X
ncy ancock Street Atlantic Fire (Station)	1880-007	332400 4682100	3	Suburban- Residential					X

II. 1981 SITE DIRECTORY

SITE LOCATION	SAROAD # DIST. #	UTM COORD. EAST NORTH	REC HGT (M)	STATION TYPE	POLLUTANTS SAMPLED				
					SO ₂	CO	O ₃	NO ₂	TSP
Woburnville Powder House Blvd Tufts University	2100-003	<u>326500</u> 4696550	5	Suburban- Residential	X	X	X	X	
Woburnbury Water Row Road (Great Meadows Nat'l Wildlife Reserve)	2196-001	<u>303350</u> 4695100	5	Rural- Agricultural			X		
Woburntertown Victory Field	2380-005	<u>320310</u> 4693500	4	Center City- Residential	X				
Woburnburn Woburn St. & Montvale Ave. (Middlesex Cty. Court)	2620-002	<u>323000</u> 4705000	12	Suburban- Commercial					X

PIONEER VALLEY AIR QUALITY CONTROL REGION

Woburnawam 1615 Suffield St. (Tenn. Gas Pipe- line Dist.)	0030-002	<u>695700</u> 4656250	3	Rural- Near Urban			X		
Woburnicopee 939 Chicopee St.	0400-005	<u>697900</u> 4673400	4	Center City- Industrial	X				X
Woburnlyoke 1 Court Square (Top of District Court House)	0860-007	<u>697480</u> 4674500	12	Center City- Commercial					X

II. 1981 SITE DIRECTORY

STATION LOCATION	SAROAD # DIST. #	UTM COORD. EAST NORTH	REC HGT (M)	STATION TYPE	POLLUTANTS SAMPLED				
					SO ₂	CO	O ₃	NO ₂	TSP
Springfield 586 E. Columbus Ave.	2160-007	698000 4662000	6.5	Center City- Commercial	X				
Springfield Longhill Ave. (substation)	2160-009	700000 4661928	6	Center City- Commercial	X				
Springfield 9 Howard St. (Howard St. School)	2160-011	699460 4663380	19	Center City- Commercial					X
Springfield Greenbank St. near Boston Rd.	2160-014	707080 4668200	4	Suburban- Commercial	X	X	X		
Springfield Community/Tech. College	2160-015	700000 4664500	15	Center City- Residential	X			X	
Springfield St. 32 (Ware High School)	2360-001	696400 4663940	4	Suburban- Commercial			X		
Springfield Dan Deene St. Fire Dept. (headqtrs.)	2475-003	696400 4663940	7	Suburban- Commercial					X

SOUTHEASTERN MASSACHUSETTS AIR QUALITY CONTROL REGION

Springfield 100 Main St. (Fire Station)	0120-002	311000 4644000	5	Center City- Residential	X				X
Springfield 47 Park St. (LaSalette Shrine)	0120-003	312200 4644300	11	Suburban- Commercial	X		X		

II. 1981 SITE DIRECTORY

TYPE LOCATION	SAROAD #	UTM COORD. EAST NORTH	REC HGT (M)	STATION TYPE	POLLUTANTS SAMPLED				
	DIST. #				SO ₂	CO	O ₃	NO ₂	TSP
11 River 165 Bedford St. (Central Fire Station)	0580-001	321000 4618000	15	Center City- Commercial					X
11 River Globe Street	0580-004	319700 4616900	5	Center City- Commercial	X				
untion 88 Washington St. (Morton Hospital)	2240-001	326400 4641200	20	Center City- Commercial					X

III. SAMPLING RESULTS FOR CONTINUOUS DATA

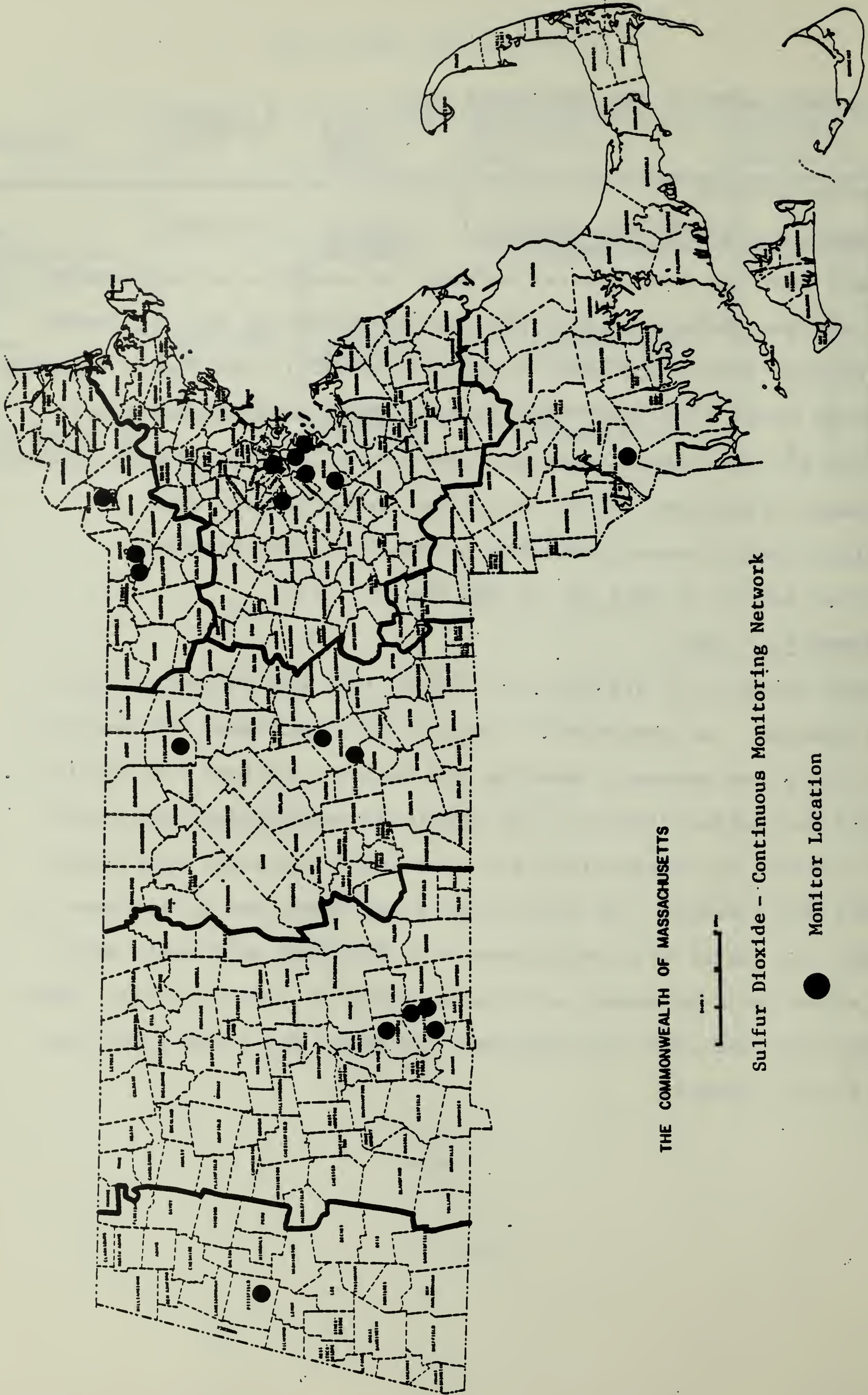
A. Sulfur Dioxide

Sample Collection and Analysis

DAQC uses two instrumental methods for analysis of continuous sulfur dioxide concentrations. The manufacturers of this equipment are: Philips Electronic Inc., (Phillips PW 9700), and Thermo Electron Inc. (Teco Model 43). The Phillips instrument employs coulometric titration and the Thermo instrument employs pulse fluorescent as their measurement principles. Both analytical methodologies meet equivalency requirements published by the U.S. Environmental Protection Agency in Part 53, 40 CFR May 10, 1979.

Summary of Data

DAQC operated 19 stations for SO₂ in 1981 and collected 125,761 hourly samples. As presented in Table 5 all continuous SO₂ monitors in the state are presently meeting the National Ambient Air Quality Standard for sulfur dioxide. The continued restrictions upon fuel sulfur content are responsible for successful statewide compliance with the SO₂ standard. At two of the sites there was an increase in the 1981 SO₂ annual arithmetic mean over the 1980 arithmetic mean; eight sites recorded annual arithmetic means in 1981 less than those recorded for 1980, one site remained the same; and 8 new sites were added to the network.



THE COMMONWEALTH OF MASSACHUSETTS

Sulfur Dioxide - Continuous Monitoring Network

● Monitor Location

— Air Quality Control
Region Boundaries

TABLE 5

1981 SULFUR DIOXIDE SUMMARY

SO₂ units: UG/M³

	Saroad #	Instrument Method	*Number of Hourly obs.	Annual Arith. Mean	Max. 24 hr obs. daily	2nd Max 24 hr obs.	Max. 3 hr obs.	2nd Max 3 hr obs.	Max 1 hr obs.	2nd max 1 hr. obs.
<u>BERKSHIRE AIR QUALITY CONTROL REGION (117)</u>										
Worcester	1800-005	14	7460	24	178	134	272	258	346	296
<u>CENTRAL MASSACHUSETTS AIR QUALITY CONTROL REGION (118)</u>										
Worcester	0620-003	14	8224	13	136	118	222	199	254	249
Worcester	2640-017	14**	7360	31	136	115	238	233	278	273
Worcester	2640-019	14	1391*	*	71	58	144	100	157	157
<u>MERRIMACK VALLEY AIR QUALITY CONTROL REGION (121)</u>										
Lowell	1000-005	14	7217	26	105	102	189	176	257	249
Lowell	1080-006	14**	3364*	21	55	50	115	110	139	139
Lowell	1080-007	14	3721*	29	118	110	105	68	330	257
<u>METROPOLITAN BOSTON AIR QUALITY CONTROL REGION (119)</u>										
Boston	0240-002	14	7883	50	180	170	343	317	435	364
Boston	0240-015	14	8139	42	189	173	296	257	341	325
Boston	0240-021	14	7998	37	126	102	215	204	294	270
Boston	0240-023	14	6389	29	178	160	288	273	383	307
Woburn	1210-001	14	7400	16	84	79	202	144	236	236
Woburn	2100-003	14	6899	31	173	136	262	257	302	302
Woburn	2380-005	20**	6879	29	155	107	249	227	322	293
<u>PIONEER VALLEY AIR QUALITY CONTROL REGION (042)</u>										
Worcester	0400-005	14	7168	31	147	136	270	254	323	315
Worcester	2160-009	14	5425	31	151	107	359	333	525	472
Worcester	2160-014	20	7359	24	99	71	149	147	315	168
Worcester	2160-015	14	7842	29	155	144	257	254	446	288
<u>SOUTHEASTERN MASSACHUSETTS AIR QUALITY CONTROL REGION (120)</u>										
Worcester	0580-004	14	7643	29	183	152	468	440	739	535

When total observations are less than 4000, the sample cannot be guaranteed to contain the actual maximum concentration value for the year.





Two analysis collection methods used at this site (14) (20)

TABLE 6

SULFUR DIOXIDE - SITE STATUS

	City	Saroad #	Operational Status			
			78	79	80	81
1.	Attleboro	0120-003	Y	Y	Y	N
2.	Boston	0240-002	Y	Y	Y	Y
3.	Boston	0240-015	N	N	N	Y
4.	Boston	0240-016	Y	Y	Y	N
5.	Boston	0240-021	Y	Y	Y	Y
6.	Boston	0240-023	N	N	N	Y
7.	Chicopee	0400-005	Y	Y	Y	Y
8.	Fall River	0580-004	Y	Y	Y	Y
9.	Fitchburg	0620-003	Y	Y	Y	Y
10.	Georgetown	0730-001	Y	Y	Y	N
11.	Lawrence	1000-003	Y	Y	Y	N
12.	Lawrence	1000-004	N	N	Y	N
13.	Lawrence	1000-005	N	N	N	Y
14.	Lowell	1080-004	Y	Y	Y	N
15.	Lowell	1080-006	N	N	N	Y
16.	Medfield	1210-001	Y	Y	Y	Y
17.	Medford	1220-003	Y	Y	Y	N
18.	Pittsfield	1800-005	Y	Y	Y	Y
19.	Quincy	1880-002	Y	Y	Y	N
20.	Somerville	2100-003	N	N	Y	Y
21.	Springfield	2160-005	Y	Y	Y	N
22.	Springfield	2160-009	Y	Y	Y	Y
23.	Springfield	2160-014	N	N	Y	Y
24.	Springfield	2160-015	N	N	N	Y
25.	Watertown	2380-005	N	Y	Y	Y
26.	Worcester	2640-012	Y	Y	Y	N
27.	Worcester	2640-017	N	N	Y	Y
28.	Worcester	2640-019	N	N	N	Y

SUMMARY - 4 Year Arithmetic Mean
for Sulfur Dioxide ($\mu\text{g}/\text{M}^3$)

 = 1978
 = 1979
 = 1980
 = 1981

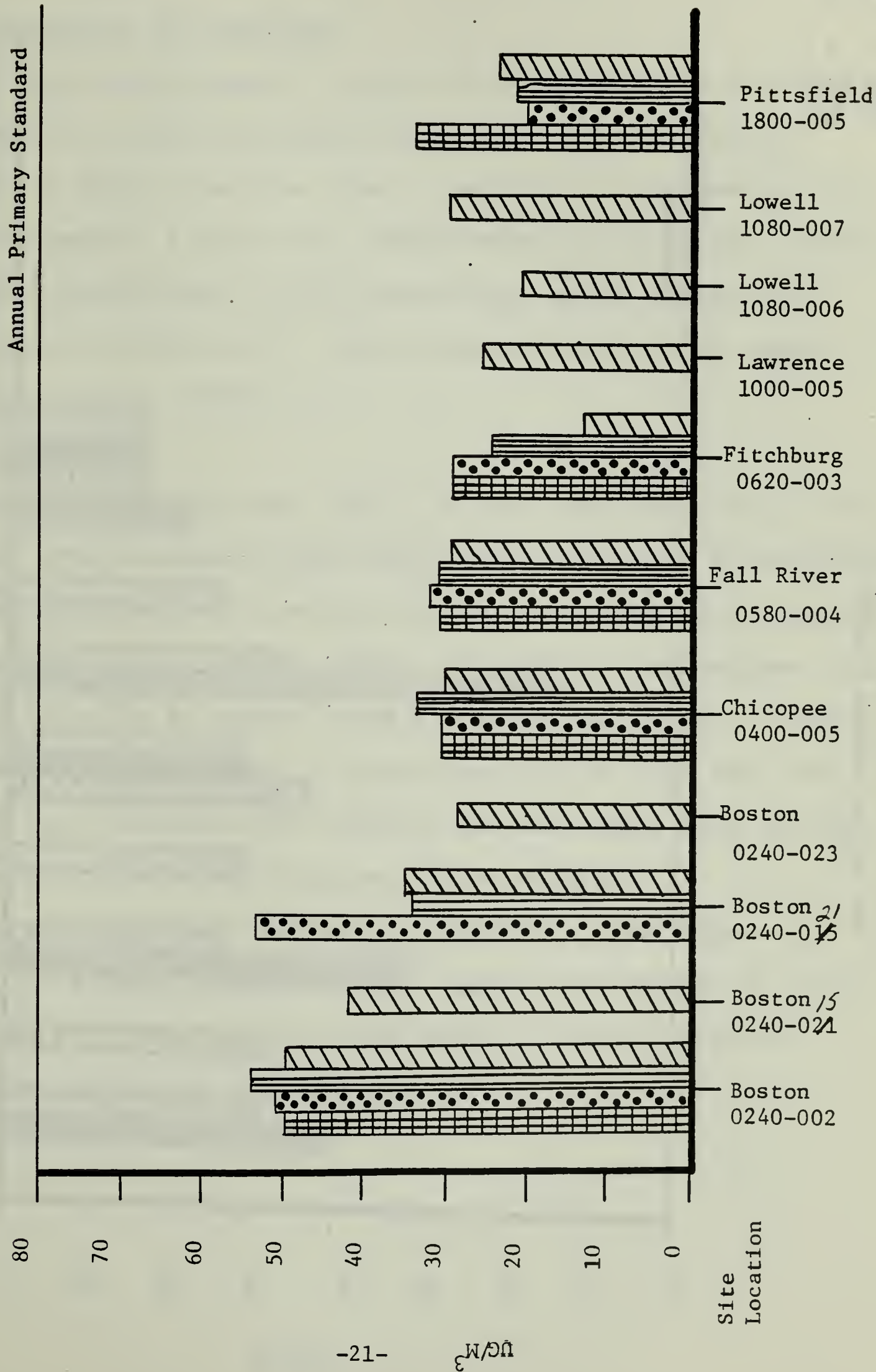
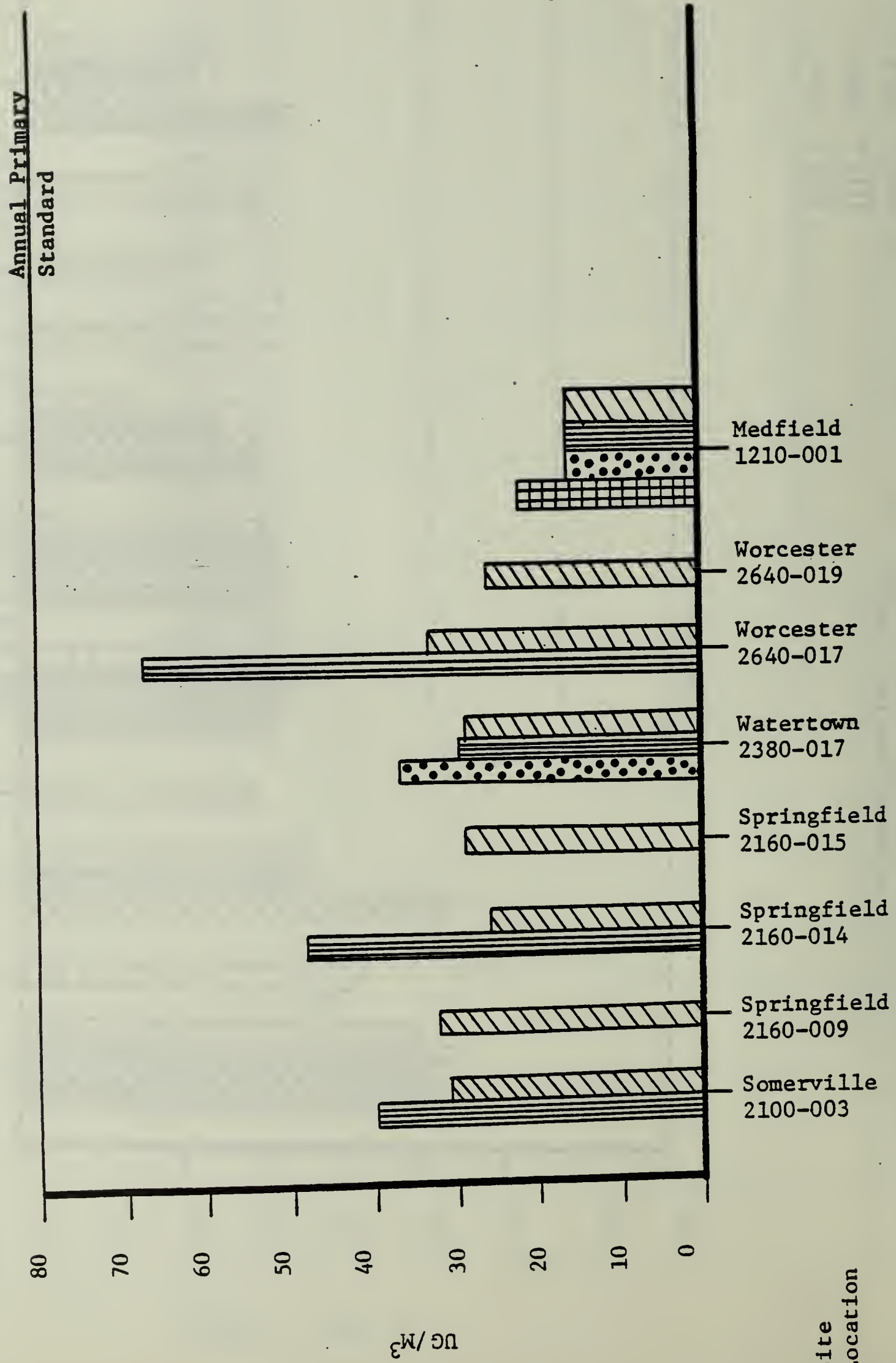


Figure 3 (cont)

SUMMARY - 4 Year Arithmetic Mean
For Sulfur Dioxide ($\mu\text{g}/\text{M}^3$)

= 1976
 = 1979
 = 1980
 = 1981



B. CARBON MONOXIDE

Sample Collection and Analysis

DAQC uses two manufacturers' models of Non-Dispersive Infrared (NDIR) analyzers for Carbon Monoxide detection. The respective manufacturers are Ethyl Intertec, Inc., and Horiba Instruments, Inc. Both instruments employ a short cell NDIR detection principle coupled with water vapor subtraction. This methodology meets equivalency requirements published by the U.S. Environmental Protection Agency in Part 58, 40 CFR, May 10, 1979.

Summary of Data

DAQC operated seven stations for CO in 1981 and collected 37,555 hourly samples. The results of this effort indicate that no violation of the one hour NAAQS occurred while several violations of the eight hour NAAQS occurred in two of the AQCR's statewide. The maximum eight hour value was recorded in Boston at the Essex Street site. A value of 14 mg/m³ was recorded. Table 7 summarizes the CO data for 1981. Figure 5 graphically displays the maximum one and eight hour values recorded at each of the sites relative to the standard.

The four-year/eight-hour comparative analysis (see Figure 6) indicates that in several instances 1981 figures are higher or equal to the 1980 figures. This could be the result of meteorological conditions occurring during this period.

FIGURE 4

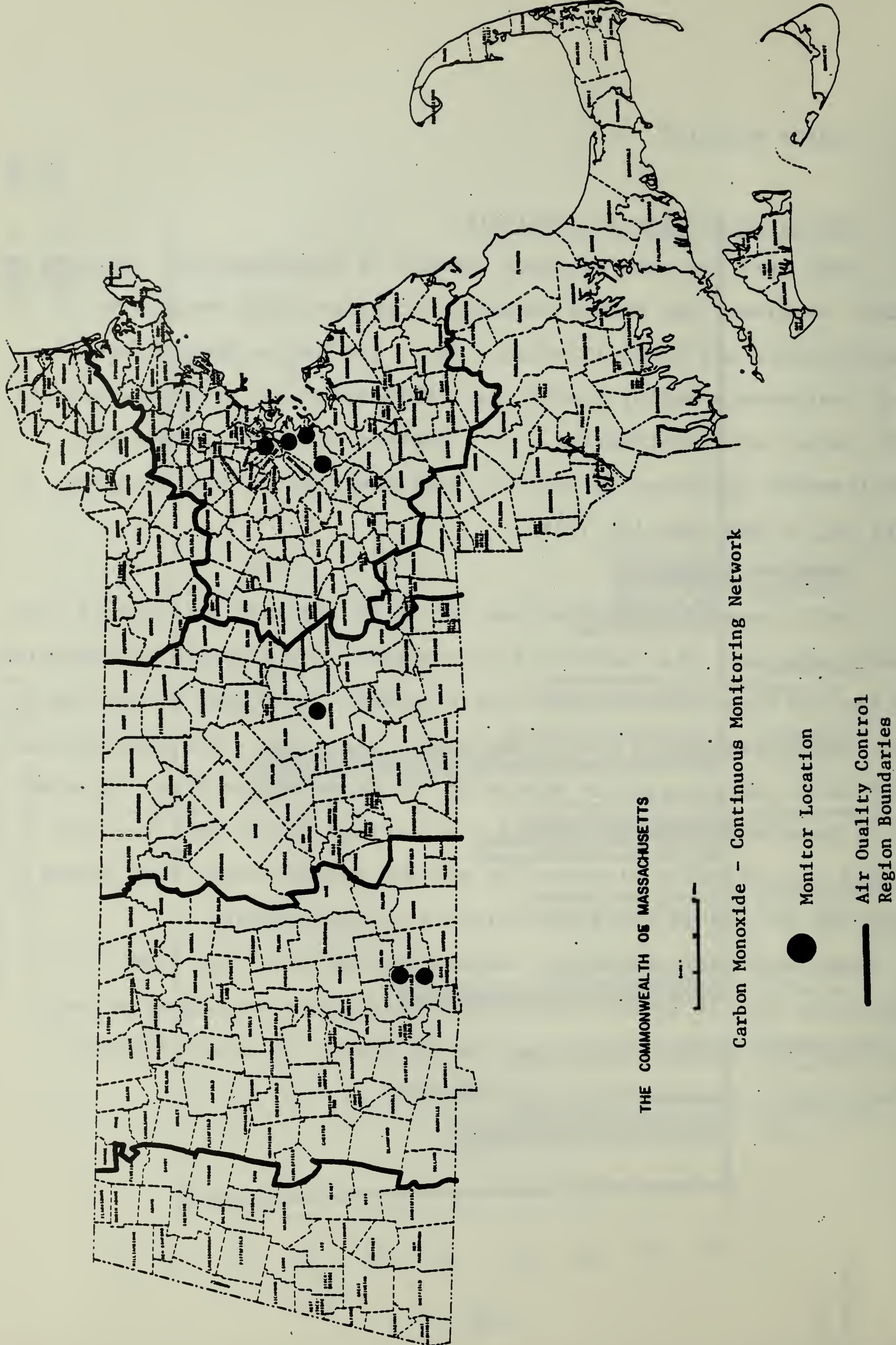


TABLE 7

1981 CARBON MONOXIDE SUMMARY

CO Units: mg/m³

	Saroad #	Instrument Method	# of obs.	*	Max. 1 hr. obs.	2nd Max 1 hr	Max 8 hr obs.	2nd Max 8 hr	# of 8 hr. averages 10 or greater
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CENTRAL MASSACHUSETTS AIR QUALITY CONTROL REGION (118)

cester	2640-012	11	1760		15	14	7	7	0
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METROPOLITAN BOSTON AIR QUALITY CONTROL REGION (119)

ton	0240-002	11	6571		22	16	14	10	2
ton	0240-021	11	7344		12	12	10	8	1
ton	0240-022	11	6512		22	22	14	12	24
erville	2100-003	11	7207		17	15	10	8	1

PIONEER VALLEY AIR QUALITY CONTROL REGION (042)

ingfield	2160-007	11	1084*		16	14	10	9	1
ingfield	2160-014	11	7077		14	10	6	6	0

When total observations are less than 4000, the sample cannot be guaranteed to contain the actual maximum concentration value for the year.

TABLE 8

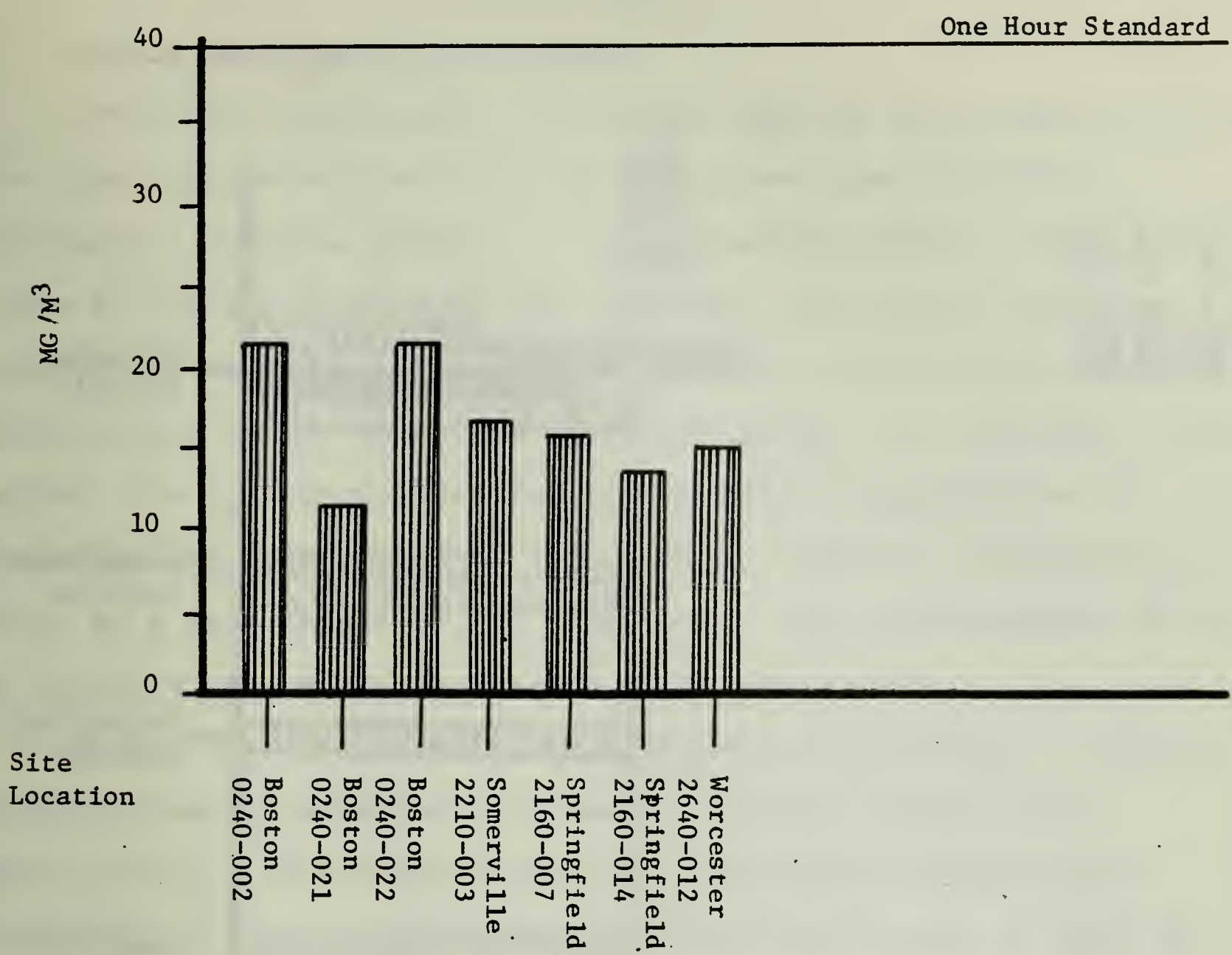
CARBON MONOXIDE SITE STATUS

Operational Status

	<u>City</u>	Saroad #	78	79	80	81
1.	Boston	0240-002	Y	Y	Y	Y
2.	Boston	0240-016	Y	Y	Y	N
3.	Boston	0240-021	N	N	Y	Y
4.	Boston	0240-022	N	N	Y	Y
5.	Lowell	1080-004	Y	Y	Y	N
6.	Medford	1220-003	Y	Y	Y	N
7.	Quincy	1880-002	Y	Y	Y	N
8.	Somerville	2100-003	N	N	Y	Y
9.	Springfield	2160-005	Y	Y	Y	N
10.	Springfield	2160-007	N	N	N	Y
11.	Springfield	2160-014	N	N	Y	Y
12.	Tewksbury	2252-001	N	N	Y	N
13.	Watertown	2380-005	N	Y	Y	N
14.	Worcester	2640-012	Y	Y	Y	Y

CARBON MONOXIDE 1981 - ONE AND EIGHT HOUR MAXIMUM

1 Hour Max.



8-Hour Max.

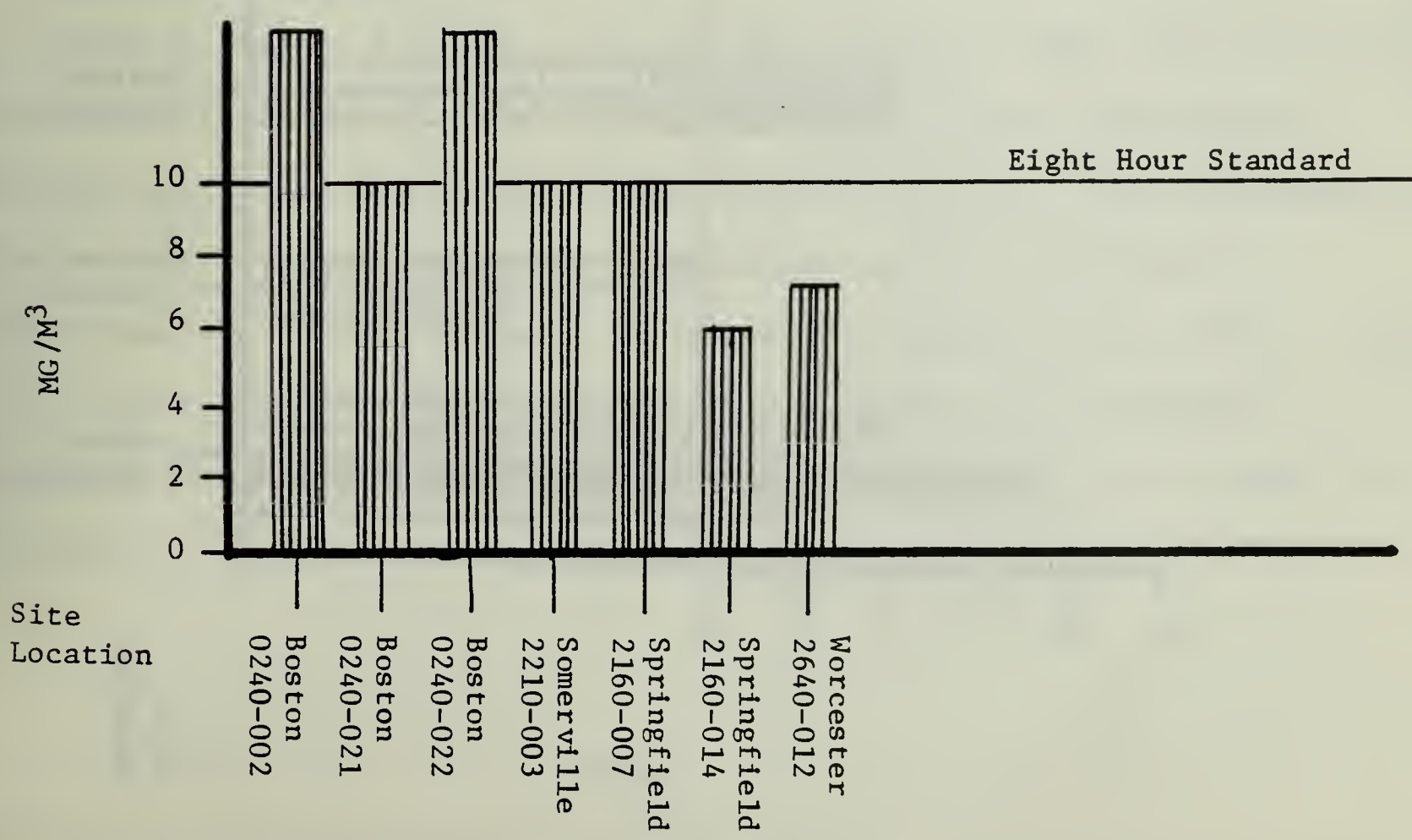
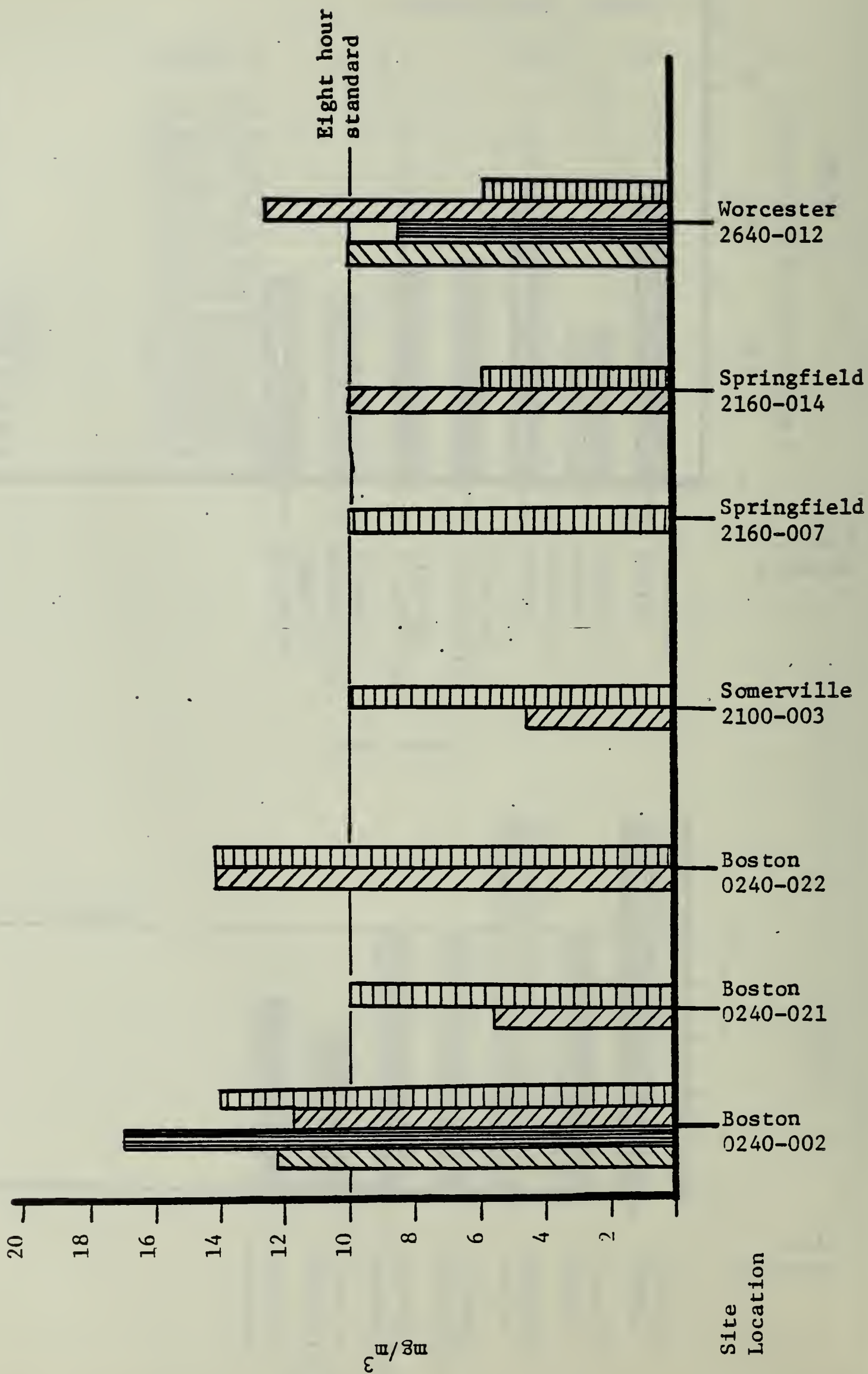
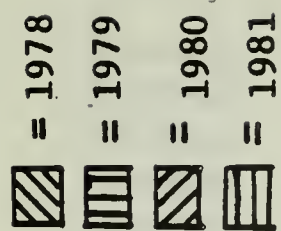


Figure 6

CARBON MONOXIDE

4 Year/8 Hour Summaries



C. OZONE

Sample Collection and Analysis

Continuous measurement of ozone is made by instruments utilizing the chemiluminescent detection principle and the ultraviolet photometric analyzer method. In the chemiluminescent method, the ozone is reacted chemically with ethylene gas and the resultant compound emits light. The intensity of the emitted light is proportional to the amount of ozone contained. In the ultra violet method, the U.V. photometer determines ozone concentration by measuring the attenuation of light due to ozone in the absorption cell, at a wave length of 254 nanometers. The concentration of ozone is directly related to the magnitude of attenuation.

Within the DAQC network the following manufacturers' models of chemiluminescent detectors are used: Monitor Labs-ML 8410A, Bendix-8101B. This methodology meets equivalency requirements published by the U.S. Environmental Protection Agency in Part 58, 40 CFR, May 10, 1979.

Summary of Data:

DAQC operated fifteen stations for ozone in 1981 and collected 64,434 hourly samples. Several of the sites within the network continue to show violations of the ozone standard. This continues to demonstrate the pervasiveness of this air quality problem in Massachusetts. Table 9 contains the ozone summaries for 1981. Figure 8, the four-year/one hour maximum values comparative analysis indicates that in most cases, the maximum recordings were lower in 1981 than in 1980.

FIGURE 7

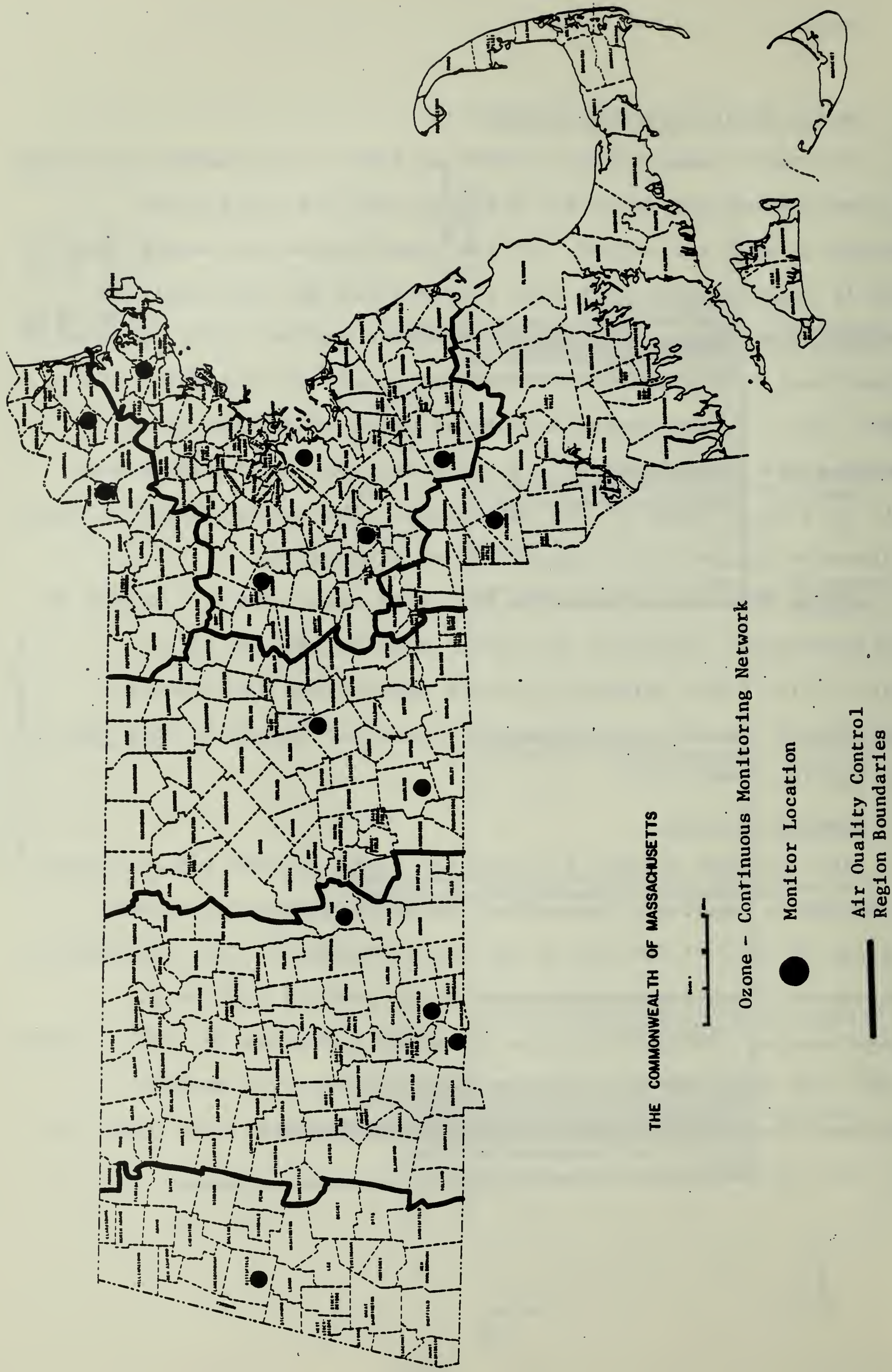


TABLE 9

1981 OZONE SUMMARY

O₃ units = (ppm)

	Saroad #	Instrument Method	# of obs.	Max. 1 hr obs.	2nd Max 1 hr obs.	3rd Max 1 hr obs.	Values > .125 measured
<u>BERKSHIRE AIR POLLUTION CONTROL REGION (117)</u>							
Worcester	1800-005	11	2425	.110	.107	.100	0
<u>CENTRAL MASSACHUSETTS AIR QUALITY CONTROL REGION (118)</u>							
Worcester	0372-001	11	4569	.160	.130	.110	2
Worcester	2640-015	11	4021	.139	.130	.123	2
Worcester	2640-019	11	3490	.125	.100	.095	1
<u>MERRIMACK VALLEY AIR QUALITY CONTROL REGION (121)</u>							
Andover	0730-001	11	1391	.053	.045	.044	0
Andover	1000-005	11	4592	.118	.102	.098	0
<u>METROPOLITAN BOSTON AIR QUALITY CONTROL REGION (119)</u>							
Worcester	0240-021	11	7711	.115	.095	.093	0
Worcester	0535-001	11	4651	.137	.130	.110	2
Worcester	0795-001	11	4393	.134	.132	.124	2
Worcester	1210-001	11	4416	.117	.108	.107	0
Worcester	2196-001	11	3039	.112	.112	.098	0
<u>PIONEER VALLEY AIR POLLUTION CONTROL REGION (042)</u>							
Worcester	0030-002	11	3975	.195	.157	.157	7
Worcester	2160-014	11	7251	.165	.143	.137	4
Worcester	2360-001	11	3909	.170	.165	.162	4
<u>SOUTHEASTERN MASSACHUSETTS AIR QUALITY CONTROL REGION (120)</u>							
Worcester	0120-003	11	4574	.125	.121	.120	1

* When total observations are less than 2000, the sample cannot be guaranteed to contain the actual maximum concentration value for the year.

TABLE 10

OZONE-SITE STATUS

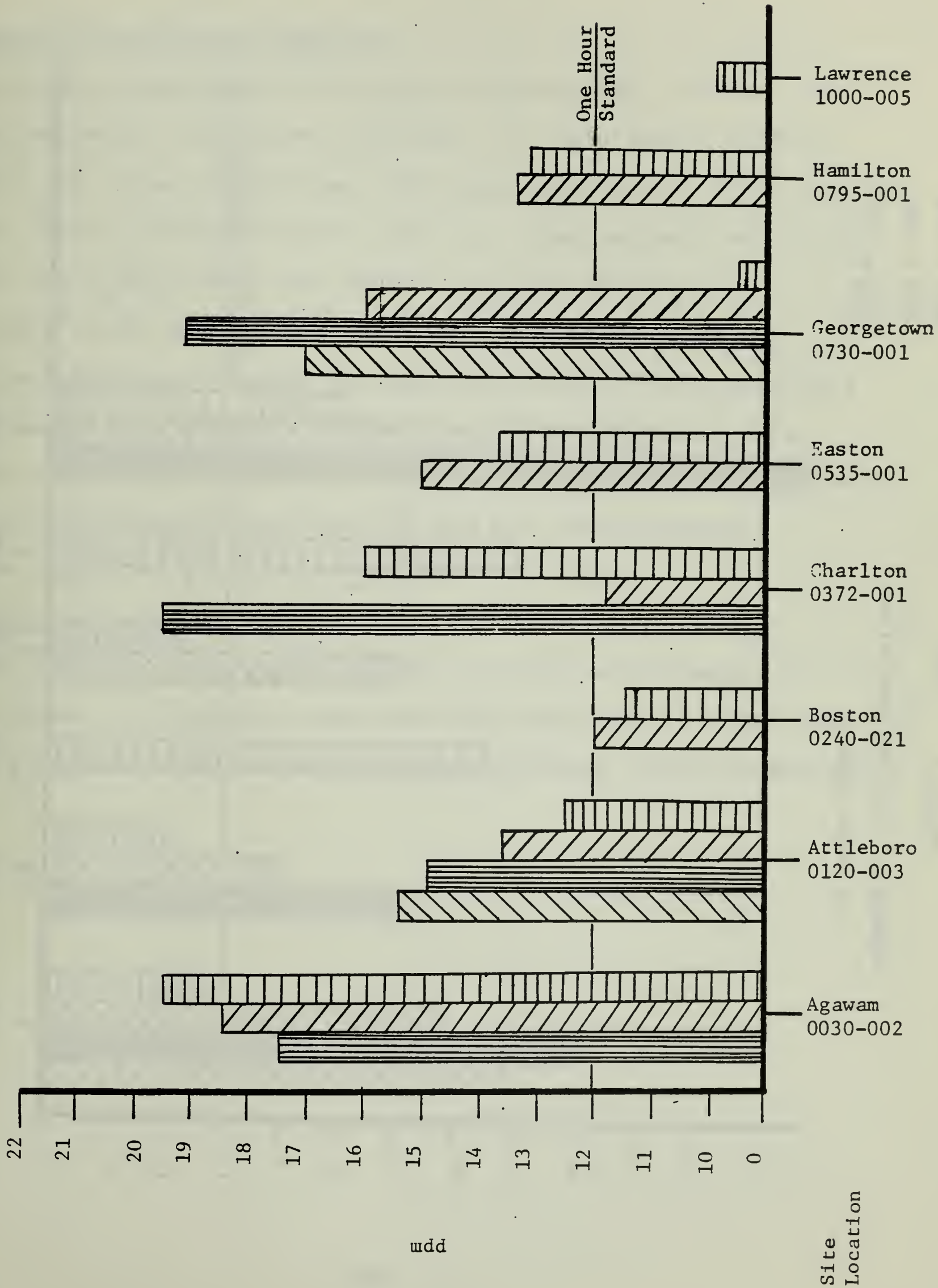
	City	Saroad #	Operational Status			
			78	79	80	81
1.	Agawam	0030-002	N	Y	Y	Y
2.	Attleboro	0120-003	Y	Y	Y	Y
3.	Boston	0240-021	N	N	Y.	Y
4.	Charlton	0372-001	N	Y	Y	Y
5.	Danvers	0480-002	N	N	Y	N
6.	Easton	0535-001	N	N	Y	Y
7.	Georgetown	0730-002	Y	Y	Y	N
8.	Greenfield	0780-002	N	Y	N	N
9.	Hamilton	0795-001	N	N	Y	Y
10.	Lawrence	1000-005	N	N	N	Y
11.	Medfield	1210-001	Y	Y	Y	Y
12.	Medford	1220-003	Y	Y	Y	N
13.	Pittsfield	1800-005	N	Y	Y	Y
14.	Quincy	1880-002	Y	Y	Y	N
15.	Somerville	2100-003	N	N	Y	N
16.	Springfield	2160-014	N	N	N	Y
17.	Sudbury	2196-001	N	N	Y	Y
18.	Tewksbury	2252-001	N	N	Y	N
19.	Ware	2360-001	N	N	N	Y
20.	Watertown	2380-005	N	N	Y	N
21.	Worcester	2640-012	Y	Y	Y	N
22.	Worcester	2640-015	N	Y	Y	Y
23.	Worcester	2640-019	N	N	N	

Figure 8

SUMMARY 4 - Year Maximum Values

For Ozone (ppm)

▨ = 1979
▧ = 1980
▩ = 1981



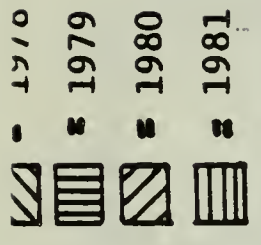
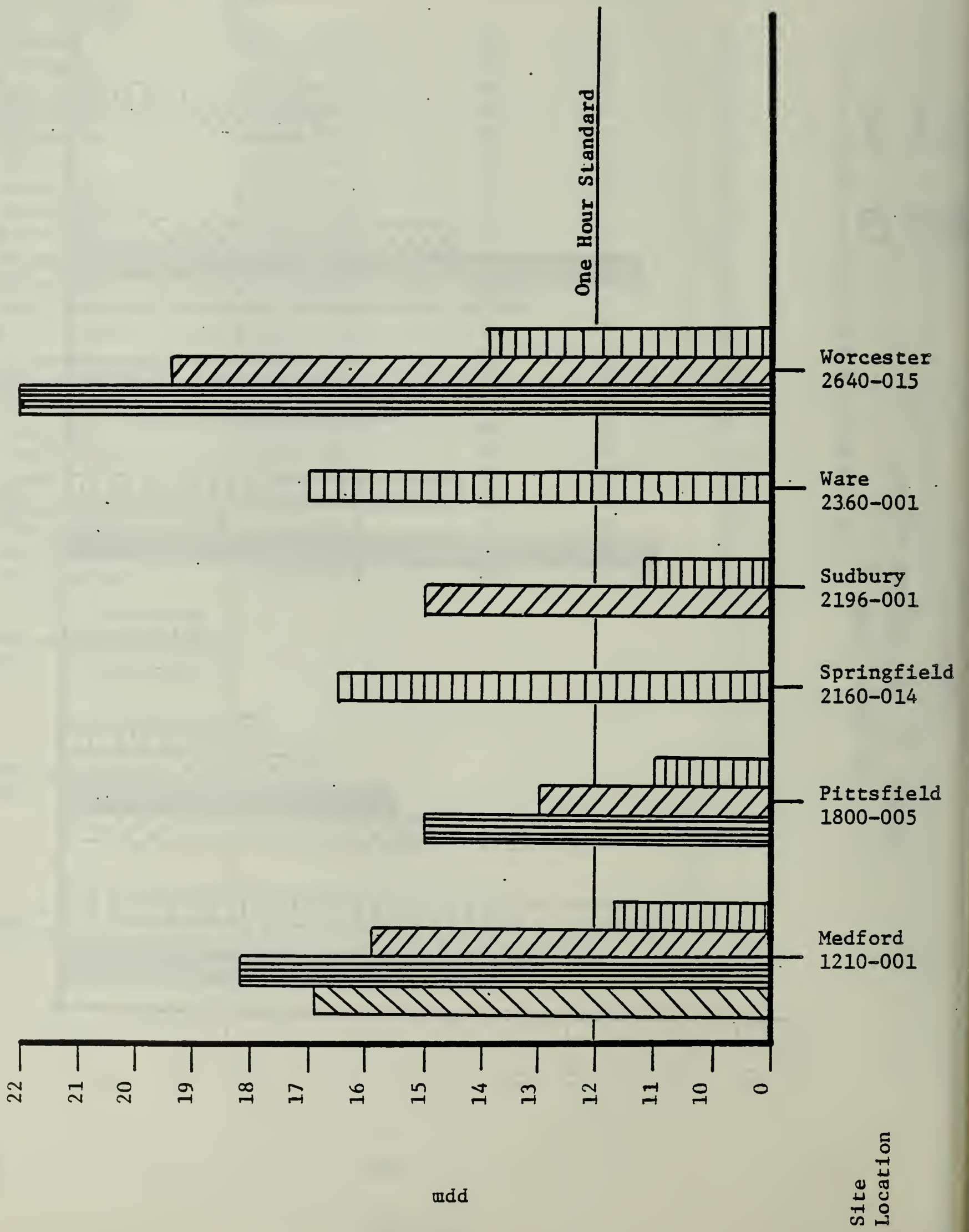


Figure 8 (cont)
 SUMMARY 4 - Year Maximum Values
 for Ozone (ppm)



D. NITROGEN DIOXIDE

Sample Collection and Analysis

Continuous measurement of Nitrogen Dioxide (NO_2) is made using the chemiluminescent detection principle. In this method, nitric oxide (NO) and oxides of nitrogen (NO_x) are reacted with ozone and the resultant chemical products emit light i.e., luminesces. As in the case with ozone analyzers, this amount of light emitted is proportional to the amount of NO and NO_x , the result being NO_2 .

Two manufacturers' models of chemiluminescent NO-NO_x analyzers are used in the DAQC network. These are: Thermo Electron Corp. - Model 14D and Monitor Lab., Inc. - Model 8440. This methodology meets equivalency requirements published by the U.S. Environmental Protection Agency in Part 58, 40 CFR, May 10, 1979.

Summary of Data

DAQC operated six stations for NO_2 in 1981 and collected 28,615 hourly samples. All stations monitored are currently in compliance with the standard. Table 11 contains the nitrogen dioxide summary for 1981.

FIGURE .9

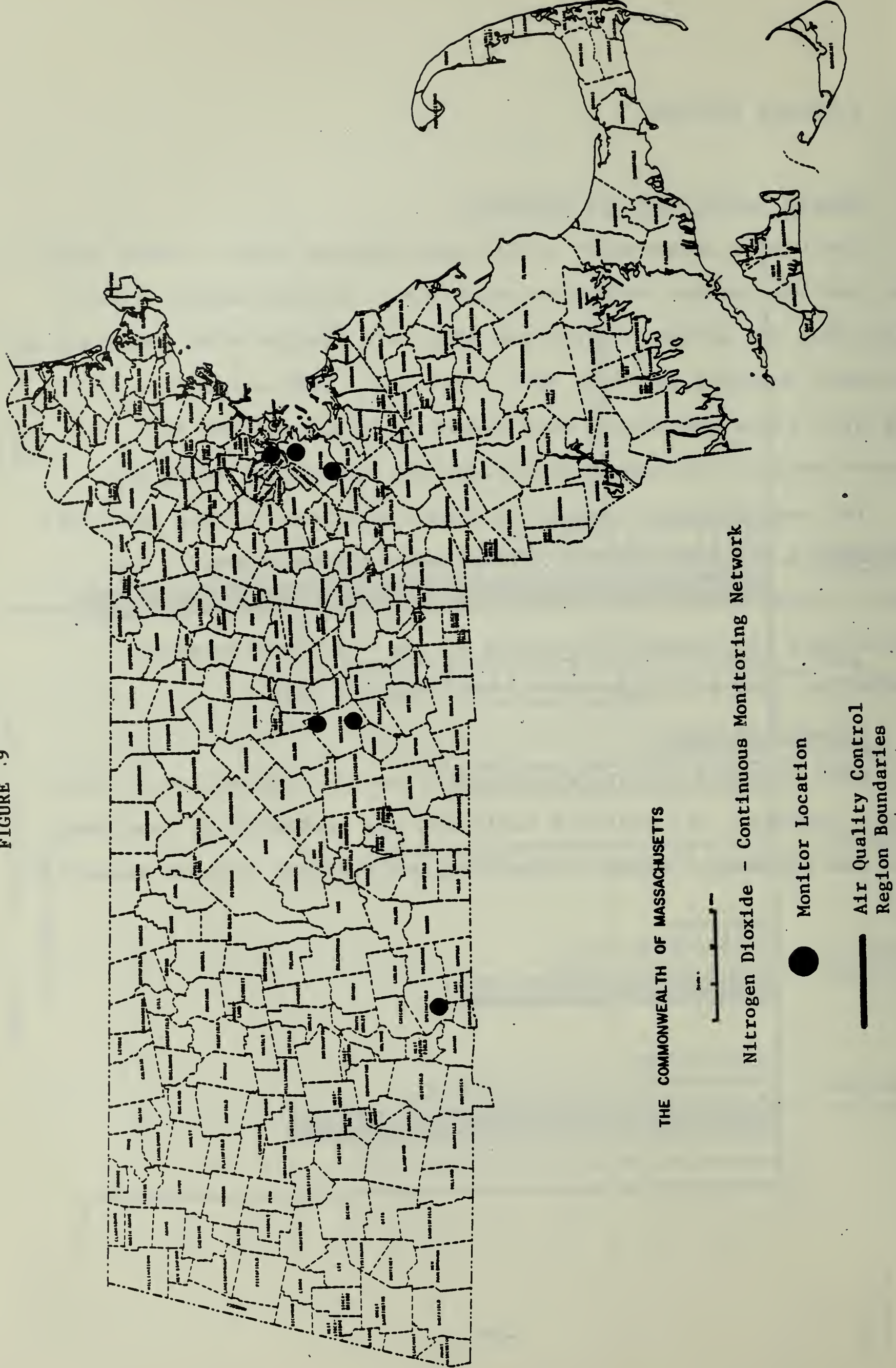


TABLE 11

1981 NITROGEN DIOXIDE SUMMARY

							NO ₂ units: (ug/m ³)
	Saroad #	Instrument Method	Number of Hourly obs.	Max 1 hr obs.	2nd Max 1 hour obs.	Arithmetic Mean	
<u>CENTRAL MASSACHUSETTS AIR QUALITY CONTROL REGION (118)</u>							
chester	2640-012	14	*1846	263	244	30	
chester	2640-019	14	*3248	301	235	30	
<u>METROPOLITAN BOSTON AIR QUALITY CONTROL REGION (119)</u>							
ton	0240-002	14	6543	376	367	71	
ton	0240-021	14	7323	214	207	55	
erville	2100-003	14	5449	201	197	47	
<u>PIONEER VALLEY AIR POLLUTION CONTROL REGION (042)</u>							
ingfield	2160-014	14	4206	291	282	OK	

When total observations are less than 4000, the sample cannot be guaranteed to contain the actual maximum concentration value for the year.

TABLE 12

NITROGEN DIOXIDE SITE STATUS

	City	Saroad #	Operational Status			
			78	79	80	81
1.	Boston	0240-002	Y	Y	Y	Y
2.	Boston	0240-016	Y	Y	Y	N
3.	Boston	0240-021	N	N	Y	Y
4.	Somerville	2100-003	N	N	Y	Y
5.	Springfield	2160-014	N	N	N	Y
6.	Watertown	2380-005	N	N	Y	N
7.	Worcester	2640-012	N	N	Y	Y
8.	Worcester	2640-019	N	N	N	Y

E. TOTAL SUSPENDED PARTICULATES

Sample Collection and Analysis

TSP measurements are routinely made using the standard high volume air sampler method every sixth day. In this procedure air is drawn through an 8"x10" fiberglass pre-weighed filter at the rate of 60 CFM for a period of 24 hours beginning at midnight. At the conclusion of the sampling, the filter is removed and transported to a laboratory for reweighing. The difference in weights in milligrams is divided by the volume of air passed through thus giving a weight per unit volume result i.e., ug/m^3 . Upon completion of the TSP (weight/unit volume) calculation, several other physical and chemical tests can be performed upon the collected sample. This methodology meets equivalency requirements published by the U.S. Environmental Protection Agency in Part 58, 40 CFR, May 10, 1979.

Summary of Data

DAQC operated twenty-seven stations for TSP in 1981 and collected 1,442 samples. The results from this effort indicate one exceedance of the annual primary standard at the Chicopee station, there were no exceedances however of the 24 hour NAAQS ($260 \text{ ug}/\text{m}^3$). It should be noted that, the 1981 tends TSP levels as indicated in Figure 11, tend to be lower over the 1980 values. In 1981 there were several violations of the secondary TSP standard recorded.

FIGURE 10

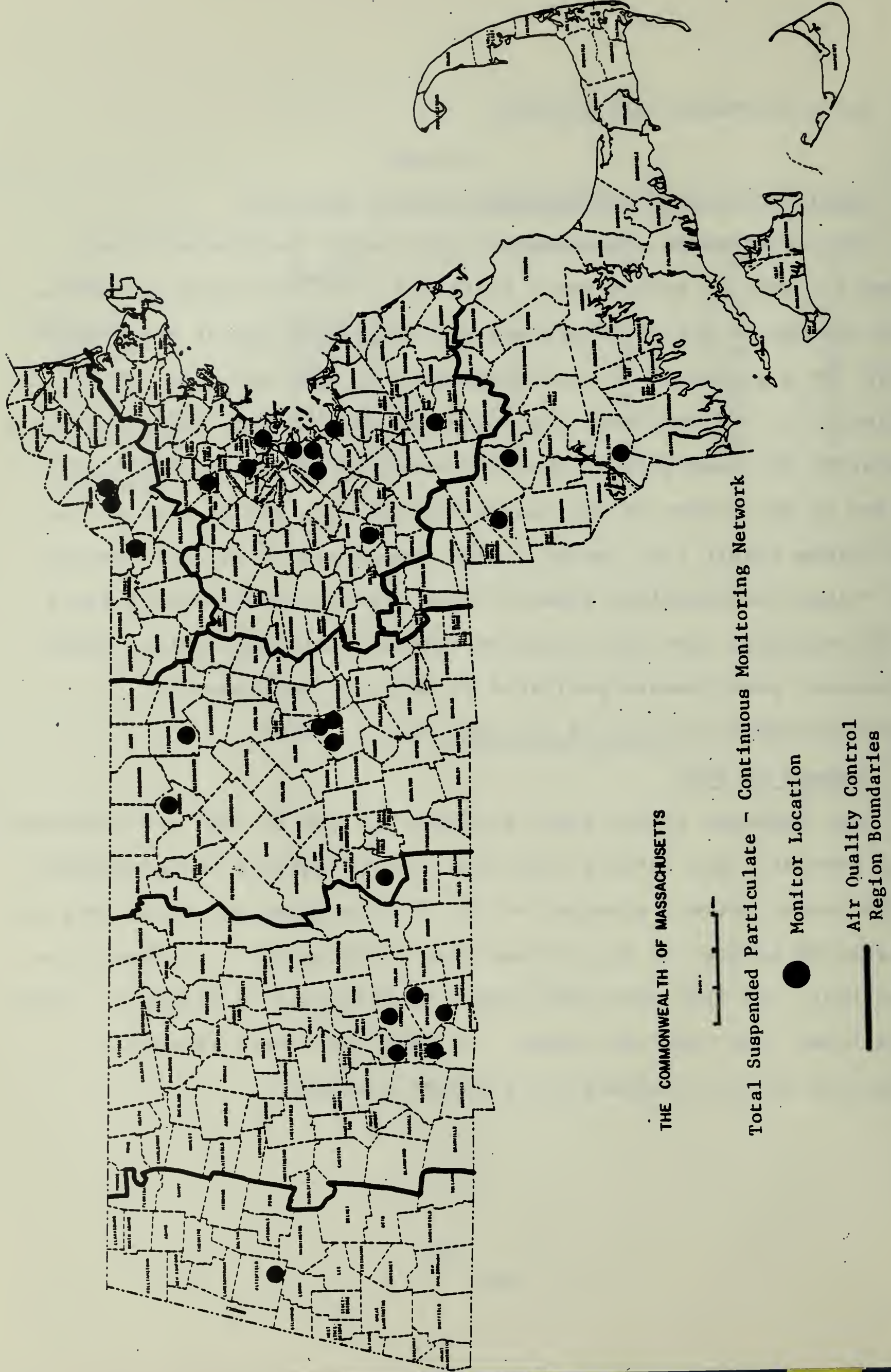


TABLE 13

1981 TOTAL SUSPENDED PARTICULATES

TSP units: (ug/m³)

	Saroad #	Number of Obs.	Minimum Obs.	1st Max Obs.	2nd Max Obs.	3rd Max Obs.	Arith. Mean	Geo. Mean
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Berkshire Air Quality Control Region (117)

Pittsfield	1800-006	43	15	129	111	107	58	51
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Central Massachusetts Air Quality Control Region (118)

Fitchburg	0620-006	14*	17	83	57	57	*	*
Gardner	0720-003	51	10	103	67	67	39	36
Warren	2372-001	45	8	78	67	61	32	28
Worcester	2640-013	56	15	161**	147	141	53	47
Worcester	2640-016	67	15	190**	156**	142	68	61
Worcester	2640-018	55	12	155**	122	107	55	49

Merrimack Valley Air Quality Control Region (121)

Lawrence	1000-003	77	14	146	117	95	44	38
Lawrence	1000-005	35	14	77	65	64	39	36
Lowell	1080-006	60	15	124	110	108	61	57

Metropolitan Boston Air Quality Control Region (119)

Boston	0240-012	73	22	111	98	98	58	55
Boston	0240-013	49	24	102	95	90	56	53
Boston	0240-024	56	22	123	97	95	66	62
Brockton	0320-003	57	7	94	89	85	43	38
Chelsea	0380-002	73	19	149	128	113	62	57
Medfield	1210-001	58	9	76	72	67	35	31
Medford	1220-002	12*	14	102	66	58	*	*
Quincy	1880-007	61	18	84	73	67	43	41
Woburn	2620-002	48	13	85	77	77	46	43

TABLE 13 (cont.)

1981 TOTAL SUSPENDED PARTICULATES

TSP units: (ug/m³)

City	Saroad #	Number of Obs.	Minimum Obs.	1st Max Obs.	2nd Max Obs.	3rd Max Obs.	Arith. Mean	Geo. Mean
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Pioneer Valley Air Quality Control Region (042)

Amherst	0400-005	115	25	224	187**	159**	80	73
Belmont	0860-007	59	17	163	119	109	59	53
Springfield	2160-011	65	15	157**	141	130	64	59
Springfield	2160-015	57	17	143	98	91	53	49
Springfield	2475-003	59	12	140	103	90	52	47

Southeastern Massachusetts Air Quality Control Region (120)

Attleboro	0120-002	13*	19	62	59	59	*	*
Mill River	0580-001	70	13	139	124	103	51	47
Worcester	2240-001	14*	12	47	44	38	*	*

*When total observations are less than 40, the sample cannot be guaranteed to contain the actual maximum concentration value for the year.
 *Represents violations of the NAAQS secondary 24 hour standard (150 ug/m³).





TABLE 14

1980 TOTAL SUSPENDED PARTICULATES-SITE STATUS

	City	Saroad #	Operational Status			81
			78	79	80	
1.	Athol	0100-001	Y	Y	Y	N
2.	Attleboro	0120-002	Y	Y	Y	Y
3.	Boston	0240-012	Y	Y	Y	Y
4.	Boston	0240-013	Y	Y	Y	Y
5.	Boston	0240-024	N	N	N	Y
6.	Boston	0240-025	N	N	Y	N
7.	Brockton	0320-003	Y	Y	Y	Y
8.	Brookline	0340-001	Y	Y	Y	N
9.	Cambridge	0360-001	Y	Y	Y	N
10.	Chelsea	0380-002	Y	Y	Y	Y
11.	Chicopee	0400-001	Y	Y	Y	N
12.	Chicopee	0400-005	N	N	N	Y
13.	Fall River	0580-001	Y	Y	Y	Y
14.	Fitchburg	0620-004	Y	Y	Y	N
15.	Fitchburg	0620-006	Y	Y	Y	Y
16.	Framingham	0660-001	Y	Y	Y	N
17.	Gardner	0720-003	N	N	Y	Y
18.	Haverhill	0840-001	Y	Y	Y	N
19.	Holyoke	0860-006	Y	Y	Y	N
20.	Holyoke	0860-007	N	N	Y	Y
21.	Lawrence	1000-003	Y	Y	Y	Y
22.	Lawrence	1000-005	N	N	N	Y
23.	Lowell	1080-005	Y	Y	Y	N
24.	Lowell	1080-006	N	N	N	Y
25.	Medfield	1210-001	Y	Y	Y	Y
26.	Medford	1220-002	Y	Y	Y	Y
27.	Needham	1480-003	Y	Y	Y	N
28.	New Bedford	1500-002	Y	Y	Y	N
29.	Northfield	1652-001	Y	Y	Y	N
30.	Norwood	1700-001	Y	Y	Y	N
31.	Pittsfield	1800-002	Y	Y	Y	N
32.	Pittsfield	1800-006	N	Y	Y	Y
33.	Quincy	1880-007	Y	Y	Y	Y
34.	Revere	1940-002	Y	Y	Y	N
35.	Springfield	2160-002	Y	Y	Y	N
36.	Springfield	2160-003	Y	Y	Y	N
37.	Springfield	2160-011	Y	Y	Y	Y
38.	Springfield	2160-015	N	N	N	Y
39.	Taunton	2240-001	Y	Y	Y	Y
40.	Warren	2372-001	Y	Y	Y	Y
41.	W. Springfield	2475-003	N	N	Y	Y
42.	Woburn	2620-002	Y	Y	Y	Y
43.	Worcester	2640-004	Y	Y	Y	N
44.	Worcester	2640-008	Y	Y	Y	N
45.	Worcester	2640-009	Y	Y	Y	N
46.	Worcester	2640-011	Y	Y	Y	N
47.	Worcester	2640-012	Y	Y	Y	N
48.	Worcester	2640-013	Y	Y	Y	Y
49.	Worcester	2640-016	N	N	Y	Y
50.	Worcester	2640-018	N	N	N	Y

FIGURE 11

SUMMARY 4 - YEAR ARITHMETIC MEAN
FOR TOTAL SUSPENDED PARTICULATES
(UG / M³)

 = 1978
 = 1979
 = 1980
 = 1981

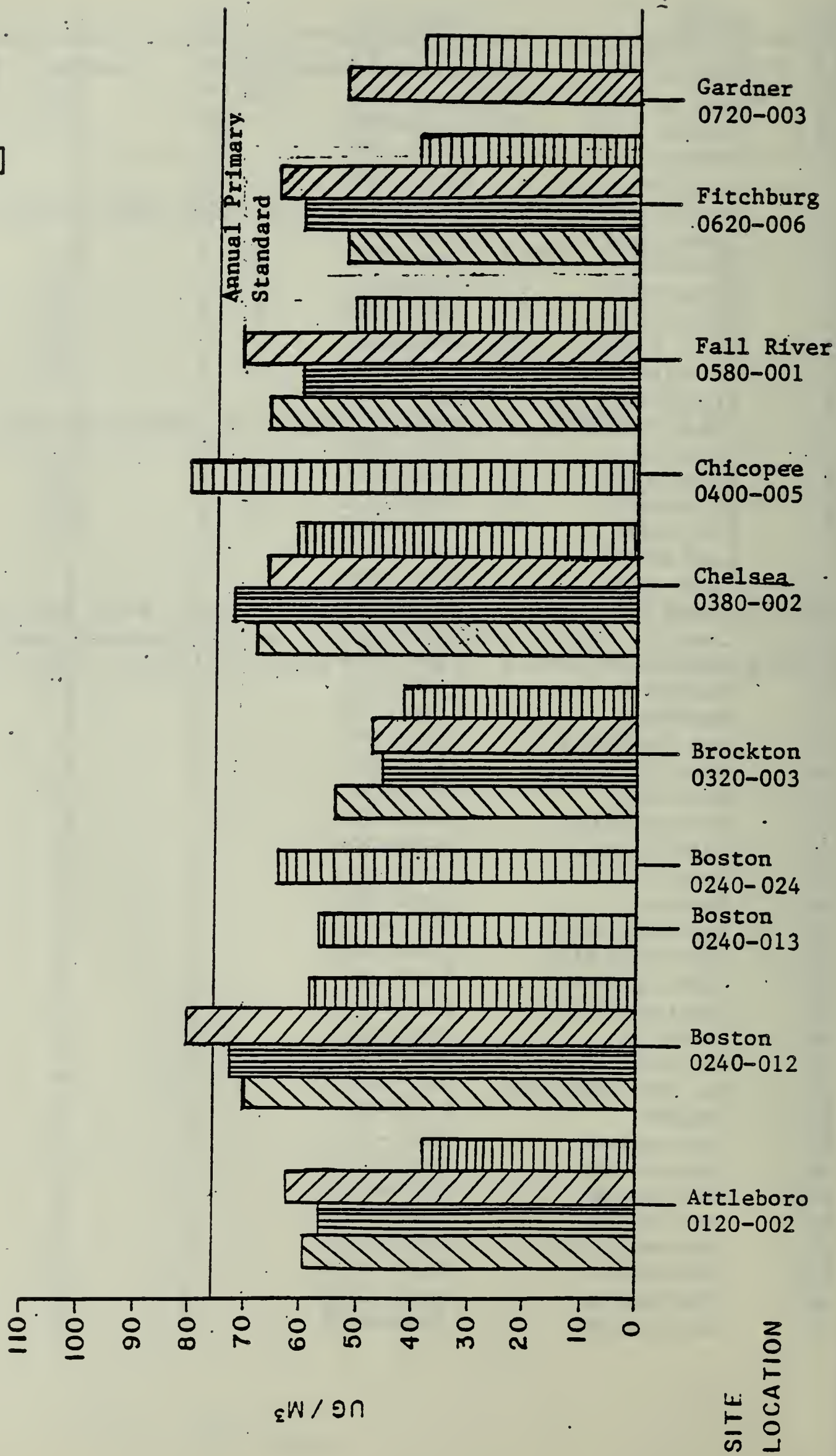


FIGURE 11 (cont)

SUMMARY 4 YEAR ARITHMETIC MEAN
FOR TOTAL SUSPENDED PARTICULATES
(UG / M³)

▨ = 1978
 ▩ = 1979
 ▧ = 1980
 ▦ = 1981

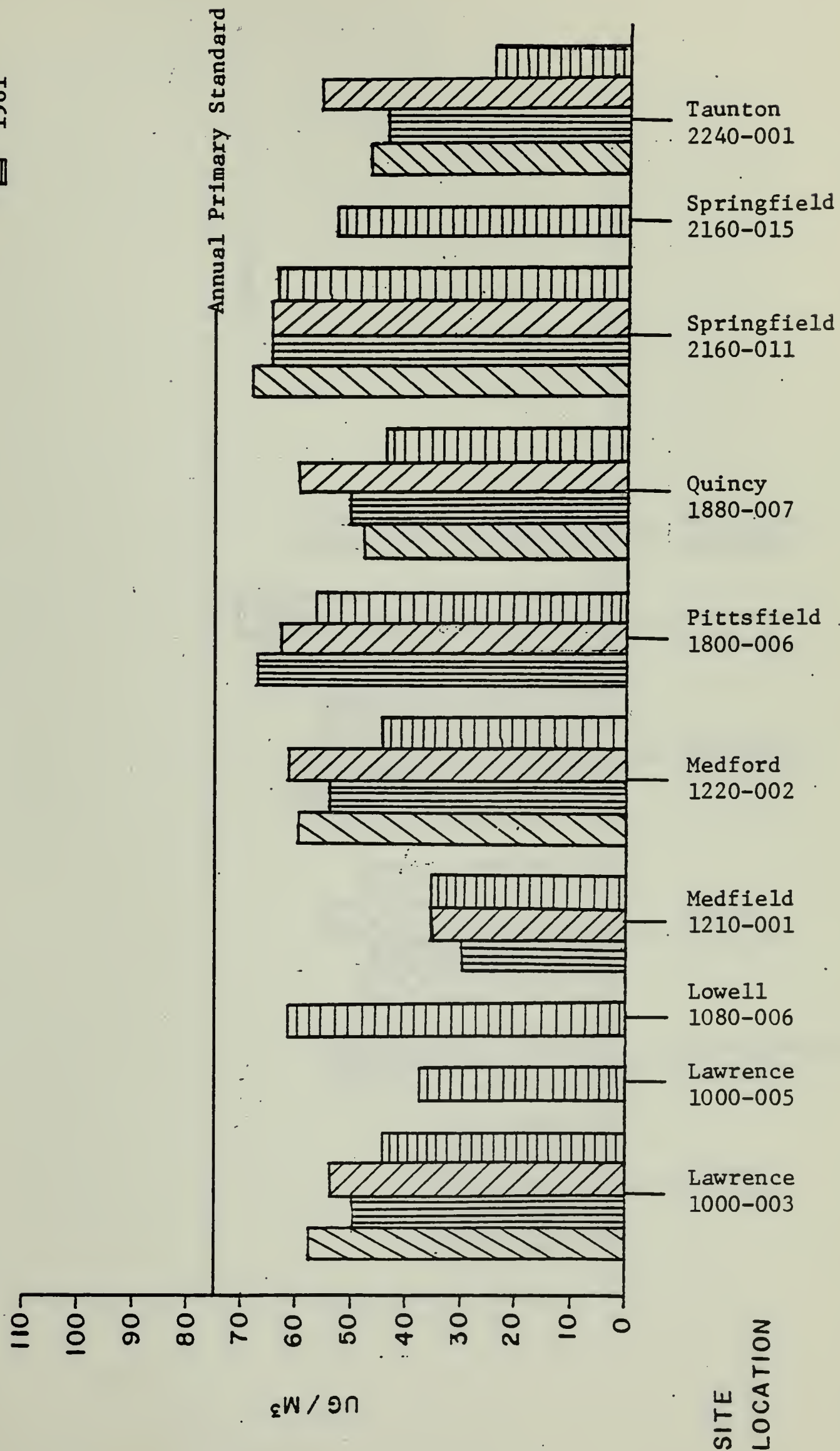




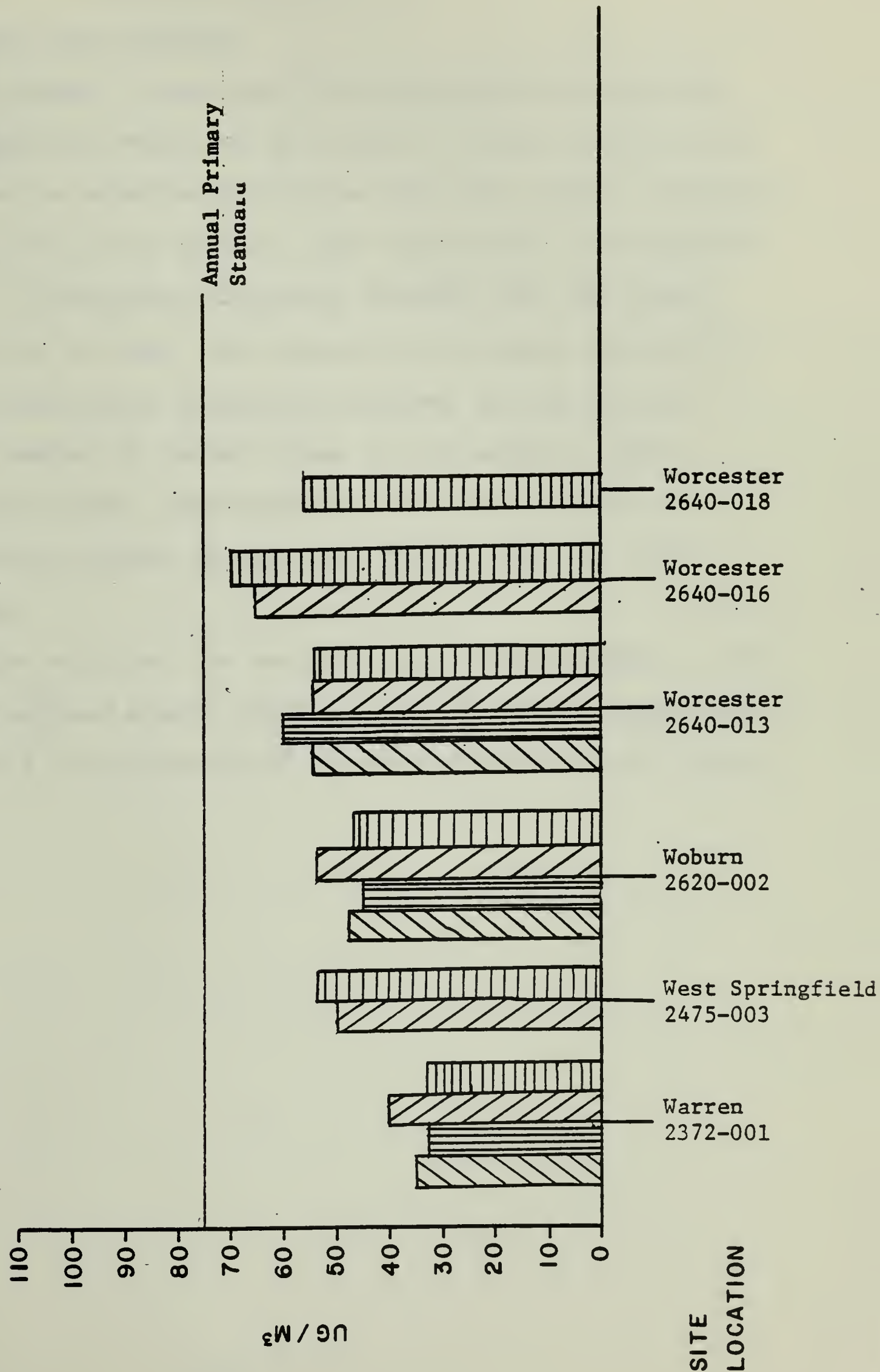


FIGURE 11 (cont)

SUMMARY 4 YEAR ARITHMETIC MEAN
FOR TOTAL SUSPENDED PARTICULATES
(UG / M³)

 = 1978
 = 1979
 = 1980
 = 1981



F. METHANE/TOTAL HYDROCARBONS

Sample Collection and Analysis

Continuous measurement of Methane/Total Hydrocarbons was made using the flame ionization detection principle. In this method, the sample to be analyzed is mixed with hydrogen fuel and passed through a small jet; air supplied to the annular space around the jet supports combustion. Carbon - containing compounds carried into the flame result in the formation of ions. An electrical potential across the flame jet and an ion collector electrode produces an ion current proportional to the number of carbon atoms in the sample. This methodology meets equivalency requirements published by the U.S. Environmental Protection Agency in Part 58, 40 CFR, May 10, 1979.

Summary of Data

DAQC operated two stations for methane/total hydrocarbons in 1981 and collected 2,467 methane hourly samples and 2,854 total hydrocarbon hourly samples. There is currently no standard established for either of these pollutants.

TABLE 15

1981 METHANE SUMMARYunits = (ug/m³)

City	Saroad #	Number of hourly obs.	Max. 1 hr. obs.	2nd. Max 1 hr obs.	Arith. Mean	Geom. Mean
------	----------	-----------------------	-----------------	--------------------	-------------	------------

CENTRAL MASSACHUSETTS AIR QUALITY CONTROL REGION (118)

orcester	2640-014	1215	1834	1769	1114	1115
----------	----------	------	------	------	------	------

PIONEER VALLEY AIR QUALITY CONTROL REGION

ringfield	2160-014	1252	1703	1703	1132	1129
-----------	----------	------	------	------	------	------

1981 TOTAL HYDROCARBONS SUMMARY

units = (ppm)

City	Saroad #	Number of hourly obs.	Max. 1 hr. obs.	2nd. Max 1 hr obs.	Arith. Mean	Geom. Mean
------	----------	-----------------------	-----------------	--------------------	-------------	------------

CENTRAL MASSACHUSETTS AIR QUALITY CONTROL REGION (118)

orcester	2640-019	1844	.90	.80	.20	.16
----------	----------	------	-----	-----	-----	-----

PIONEER VALLEY AIR POLLUTION CONTROL REGION (042)

pringfield	2160-014	1010	1.0	.90	.23	.20
------------	----------	------	-----	-----	-----	-----

G. POLLUTANT STANDARD INDEX (PSI)

PSI provides a simple, uniform way to report daily air pollution concentrations, to tell the public about the general health effects associated with these concentrations, and to describe some general precautionary steps that can be taken. PSI is a reporting tool that converts the ozone pollutant concentrations measured in the air to a simple number on a scale of 0 to 500. (See Table 16 for specific breakdown.) DEQE reports ozone PSI values daily during the months of May through September for three areas; Eastern, Central and Western Massachusetts. These reports are broadcast daily as a public information service in cooperation with the American Lung Association.

Table 17 contains the PSI summary for 1981.

TABLE 16

POLLUTANT STANDARD INDEX (PSI)

PSI values, descriptor words, generalized health effects, and cautionary statements.

Index Value	PSI Descriptor	General Health Effects	Cautionary Statement
500		Premature death of ill and elderly. Healthy people will experience adverse symptoms that affect their normal activity.	All persons should remain indoors, keeping windows and doors closed. All persons should minimize physical exertion and avoid traffic.
400	hazardous	Premature onset of certain diseases in addition to significant aggravation of symptoms and decreased exercise tolerance in healthy persons.	Elderly and persons with existing diseases should stay indoors and avoid physical exertion. General population should avoid outdoor activity.
300			
	very unhealthy	Significant aggravation of symptoms and decreased exercised tolerance in persons with heart or lung disease with widespread symptoms in the healthy population.	Elderly and persons with existing heart or lung disease should stay indoors and avoid physical activity.
200			
	unhealthy	Mild aggravation of symptoms in susceptible persons, with irritation symptoms in the healthy population.	Persons with existing heart or respiratory ailments should reduce physical exertion and outdoor activity.
100			
	moderate		
50			
	good		
0			

TABLE 17
1981 POLLUTANT STANDARD INDEX

		Eastern	Central	Western
APRIL	Good	24	27	29
	Moderate	6	3	1
	Unhealthful	0	0	0
MAY	Good	19	16	17
	Moderate	12	13	11
	Unhealthful	0	2	3
JUNE	Good	14	7	14
	Moderate	16	21	13
	Unhealthful	0	2	3
JULY	Good	14	14	16
	Moderate	78	17	15
	Unhealthful	0	0	0
AUGUST	Good	13	12	11
	Moderate	16	13	17
	Unhealthful	2	6	3
SEPTEMBER	Good	23	21	23
	Moderate	7	9	7
	Unhealthful	0	0	0

H. Atmospheric Deposition/Acid Precipitation

Sample Method and Analysis

Efforts to monitor the intensity and extent of acid deposition in Massachusetts have been recent. The oldest atmospheric deposition monitoring site, located at Woods Hole Falmouth, Massachusetts and operated by the Environmental Measurement Laboratory of the Department of Energy (DOE/EML), has been operating since 1976. At this site samples are taken of precipitation, dry deposition, wet deposition, and bulk deposition on a monthly basis. Concentrations and deposition rates are made for major anions, cations, trace elements, and specific conductivity. Precipitation volumes is also recorded.

An extensive set of deposition data exist from the Electric Power Research Institute (EPRI) monitoring site located in Montague, Massachusetts. Precipitation samples have been collected at this site on an event basis since the mid-1978. Chemical analysis is limited to the major anions and cations, specific conductance, and precipitation volume.

Because the EPRI site and the DOE/EML site are a part of limited atmospheric monitoring networks, the Department has opted to join the National Atmospheric Deposition Program (NADP) which maintains an extensive network of more than eighty (80) monitoring sites nationwide. Three NADP sites are now operating in the Commonwealth. The Truro site is owned and operated by the Cape Cod National Seashore. The other two sites are located at Cadwell Creek in Quabbin Reservoir and at the State Agriculture Experiment Station in Waltham.

The equipment at these sites is owned by the Department and operated by the University of Massachusetts. The NADP sites collect dry and wet samples on a weekly basis (Tuesday to Tuesday). Chemical analysis include all major anions and cations, specific conductance, and precipitation volume. Since the NADP sites have been in operation for only several months, precipitation chemistry data are not available.

The Department through its Lawrence Experiment Station (LES) and in cooperation with research scientists from Massachusetts universities has initiated a precipitation monitoring network. Precipitation chemistry is recorded for each precipitation event on an event basis. In-storm monitoring is conducted on a limited basis. A substantial data base exists for the LES site which has been operating since March 1981. Other data bases are equally extensive but not available at this time. The location of the various monitoring sites in Massachusetts is depicted in figure 1.

Summary of Data

a. Acidity

Precipitation falling on Massachusetts is very acidic. The average monthly weighted acidity for the EPRI site during the July 1978 through June 1980 sampling period was 83 ueq H⁺/l (N = 21, pH 4.08). In comparison, the DOE/EML site recorded an average monthly weighted acidity of 53 ueq H⁺/l (N = 42) or a pH 4.28 (July 1976 through March 1981). The monthly range for the EPRI site was 143 - 4.8 ueq/l (pH 3.84 - pH 5.3), and that for the DOE/EML site was 305 - 10.4 ueq H⁺/l (pH 3.51 - pH 4.98). As depicted in figures 13 and 14 precipitation acidity at both sites was most intense (lowest pH) during warm months, while the lowest acidities (highest pH values) were recorded during the winter months.

b. Sulfate and Nitrate Deposition

The acidity in precipitation falling on Massachusetts and the greater Northeast is determined by the concentration of sulfuric acid and nitric acid in the precipitation. Because the EPRI site and DOE/EML site are located in different precipitation zones, (coastal sites receive most precipitation during the winter and spring, while inland sites receive most precipitation during the spring and summer months) a comparison of the two data sets requires an assessment of the contribution from seaspray sulfate to the coastal DOE/EML site. On the average, roughly 18% of the sulfate present in wet deposition at Woods Hole can be attributed to seaspray. Individual storms, however, differ considerably. The weighted average excess $\text{SO}_4 =$ concentration in precipitation (total $\text{SO}_4 - \text{SO}_4$ from seaspray) sampled at the DOE/EML site was 47 ueq/l (28 mmoles/l). This value compares well with the weighted monthly SO_4 concentration in precipitation at the EPRI monitoring site (58 ueq/l or 29 umold/l) where little or no seaspray enrichment occurs.

The concentration of nitrate in precipitation sampled is generally less than that for sulfate at both monitoring sites. Since there is little or no enrichment of NO_3 from seaspray no data corrections need be applied for nitrate samples at the Woods Hole DOE/EML site. The weighted average monthly concentration of nitrate at the DOE/EML site was determined to be 26.2 ueq/l or 23 mmoles/l. The concentration of nitrate in precipitation at the EPRI site was slightly higher. The weighted monthly average nitrate concentration at the EPRI site was ueq/l or 29 umoles/l.

Seasonal differences in the concentration of sulfate and nitrate are depicted in figures 15 and 16. From these figures it is evident that sulfate is more concentrated and dominates summer precipitation. Nitrate on the other hand does not show the dramatic seasonality shown by sulfate.

c. Toxic and Trace Elements Deposition

The DOE/EML for toxic and trace element deposition are presented in table . Because these data are very limited, few conclusions can be made to toxic and trace element concentration in precipitation and overall deposition. However, toxic and trace element deposition appears to be dominated by four elements; aluminum, iron, lead, and zinc.

Figure 12

ATMOSPHERIC DEPOSITION MONITORING SITES

EVENT MONITORING SITES - MEASURE INDIVIDUAL RAIN AND SNOW STORMS

WEEKLY MONITORING SITES - MEASURE WET DEPOSITION AND DRY DEPOSITION ON A WEEKLY BASIS

MONTHLY MONITORING SITES - MEASURE WET DEPOSITION, DRY DEPOSITION, AND BULK DEPOSITION ON A MONTHLY BASIS

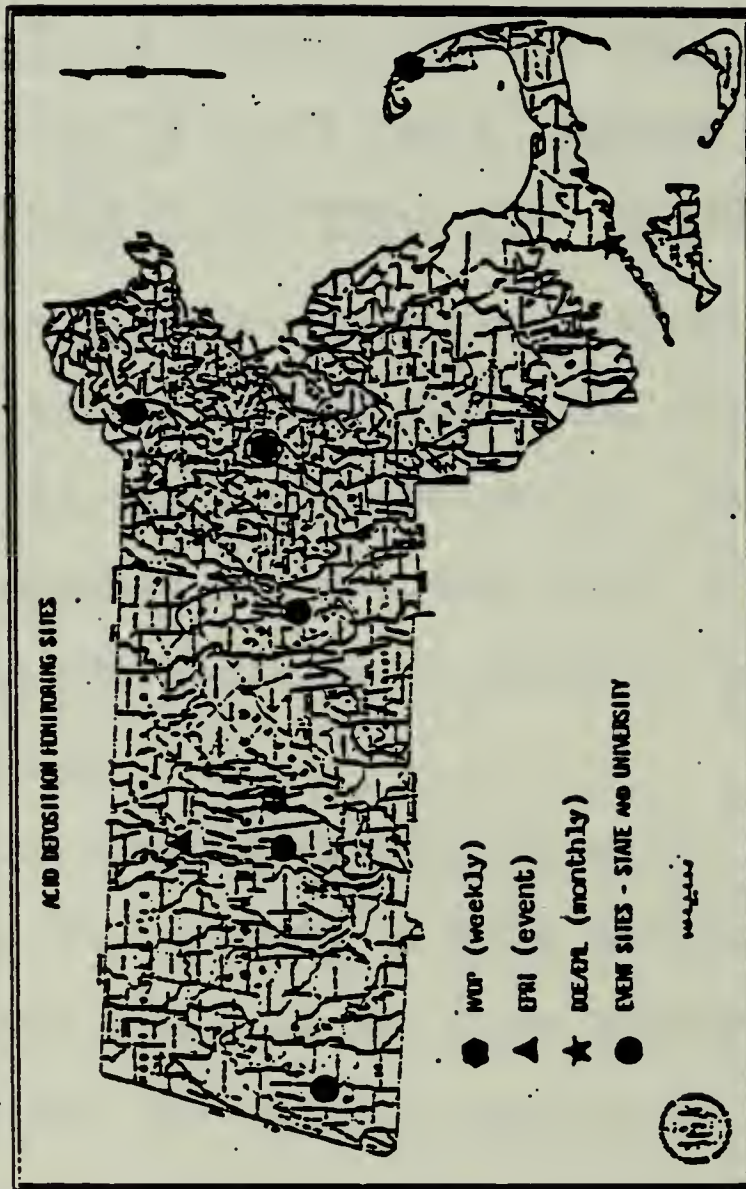


Figure 13

CHANGES IN THE HYDROGEN ION CONCENTRATION (PH) IN PRECIPITATION COLLECTED BY
THE ELECTRIC POWER RESEARCH INSTITUTE AT MONTAGUE, MASSACHUSETTS

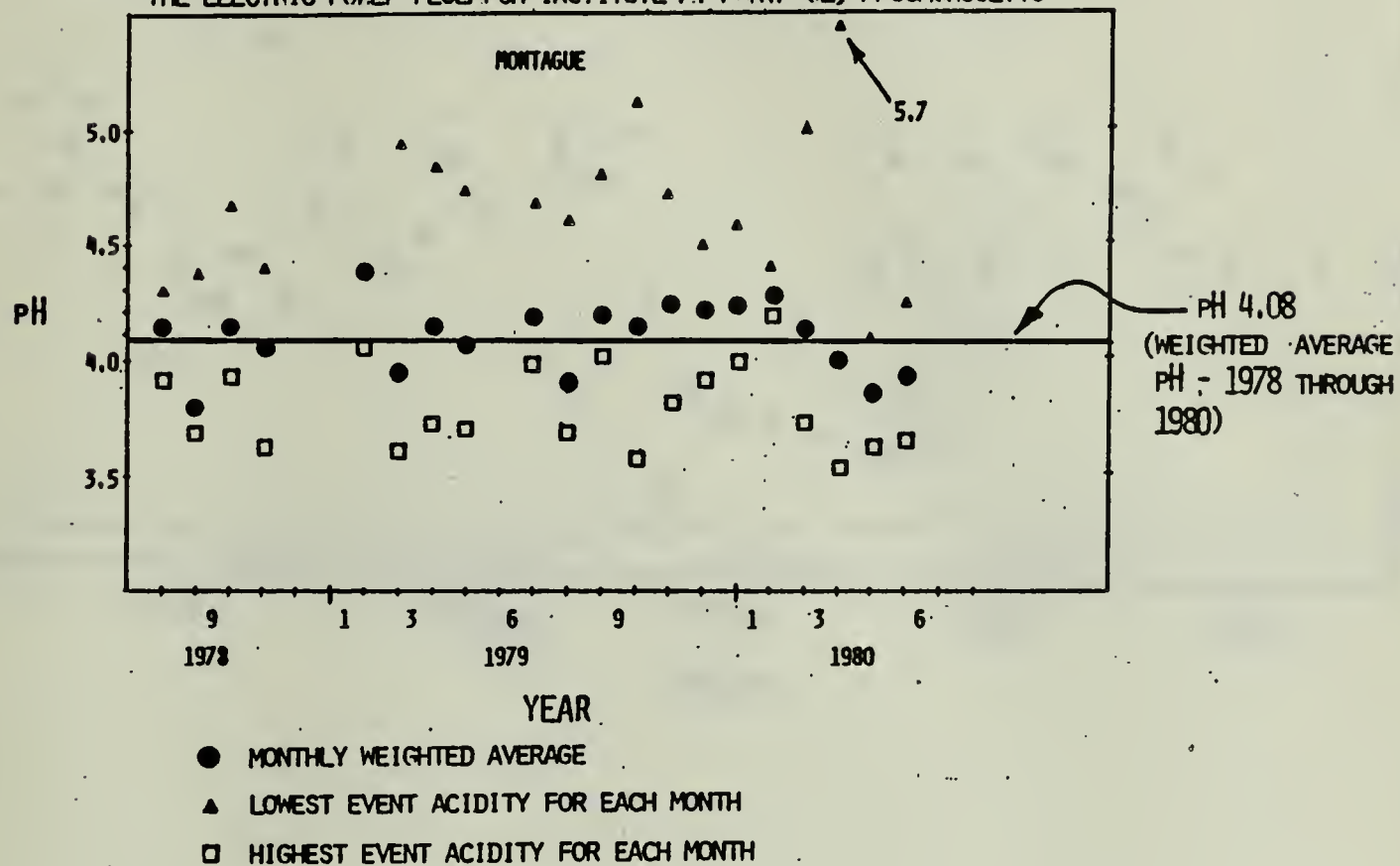


Figure 14

CHANGES IN THE HYDROGEN ION CONCENTRATION (PH) IN PRECIPITATION COLLECTED BY
DEPARTMENT OF ENERGY AT THE WOODS HOLE MONITORING SITE LOCATED IN
FALMOUTH, MASSACHUSETTS

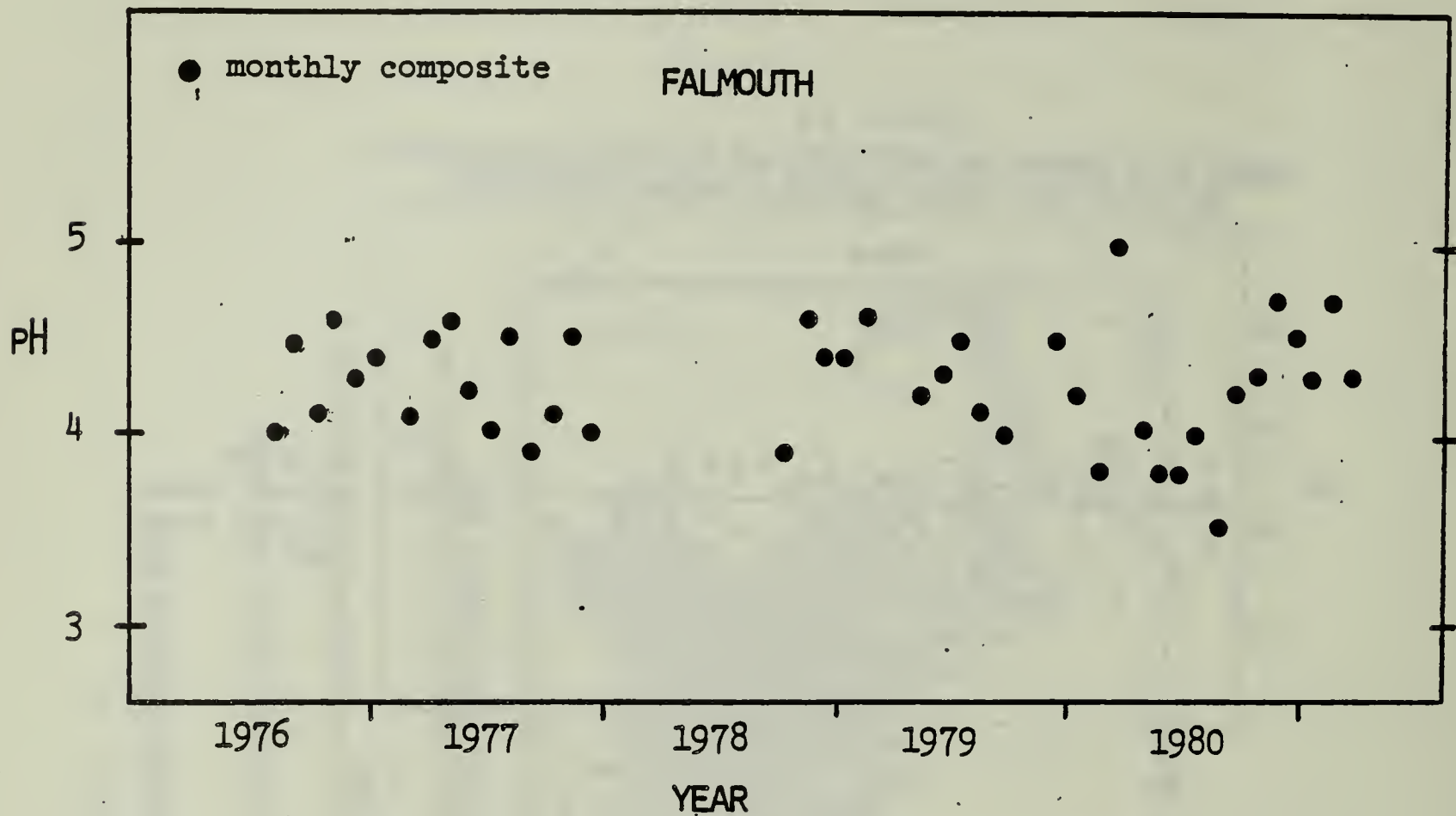


Figure 15

CHANGES IN THE CONCENTRATION OF SULFATE (UEQ/L) IN PRECIPITATION COLLECTED BY THE
ELECTRIC POWER RESEARCH INSTITUTE AT MONTAGUE, MASSACHUSETTS

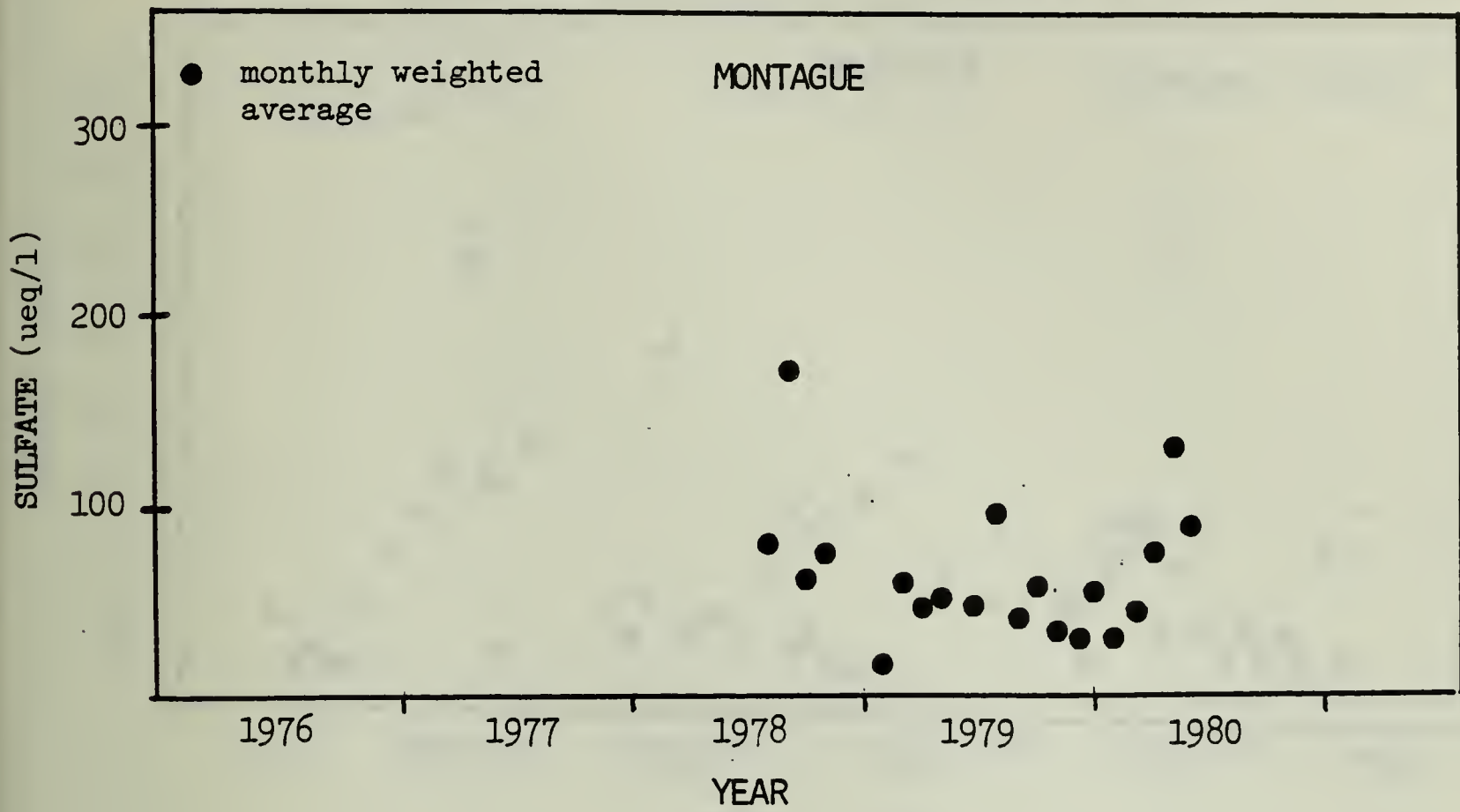


Figure 16

CHANGES IN THE CONCENTRATION OF SULFATE (UEQ/L) IN PRECIPITATION COLLECTED BY THE
DEPARTMENT OF ENERGY AT THE WOODS HOLE MONITORING SITE LOCATED IN
FALMOUTH, MASSACHUSETTS

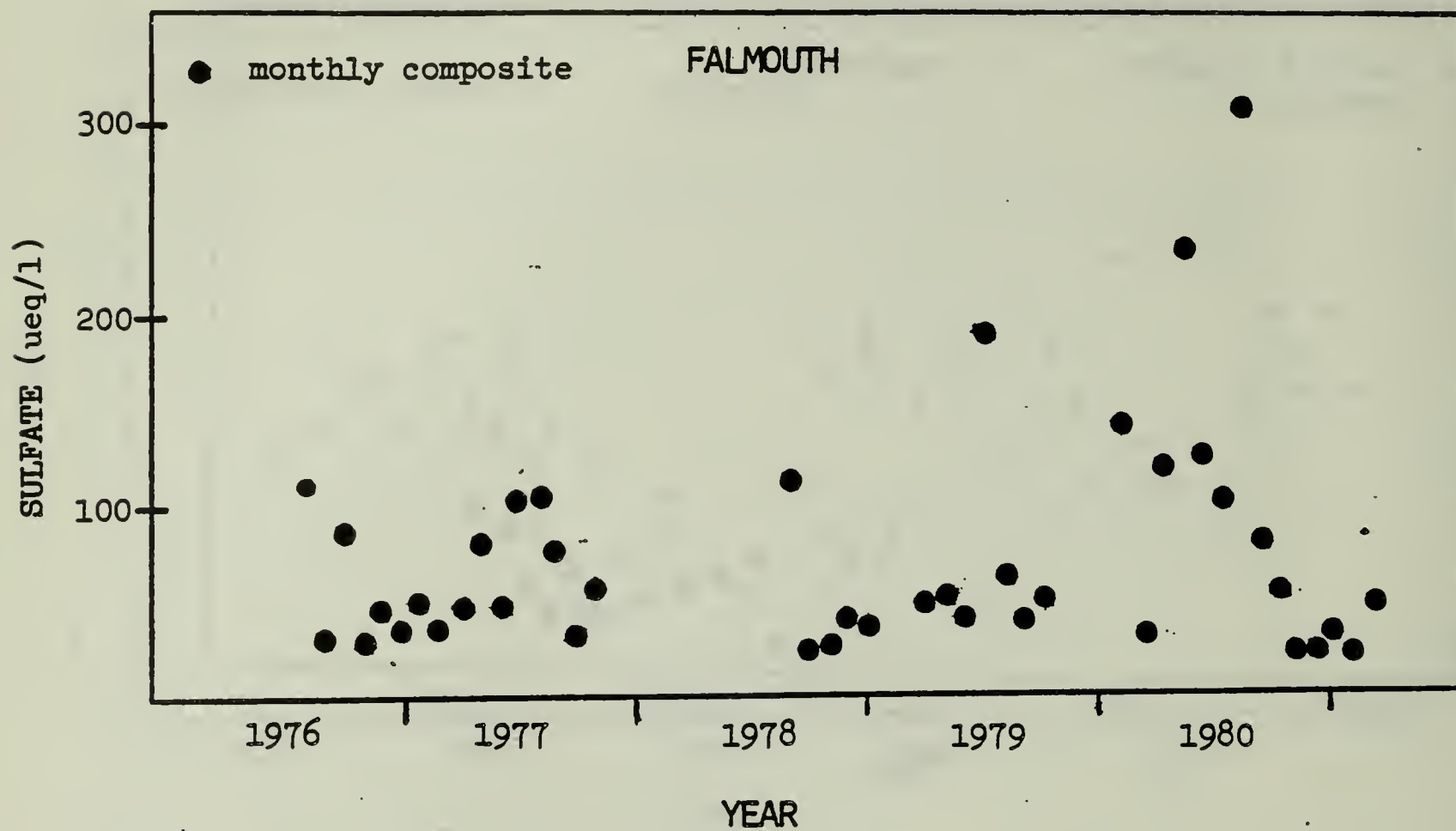


Figure 17

CHANGES IN THE NITRATE CONCENTRATION (UEQ/L) IN PRECIPITATION COLLECTED BY THE
ELECTRIC POWER RESEARCH INSTITUTE AT MONTAGUE, MASSACHUSETTS

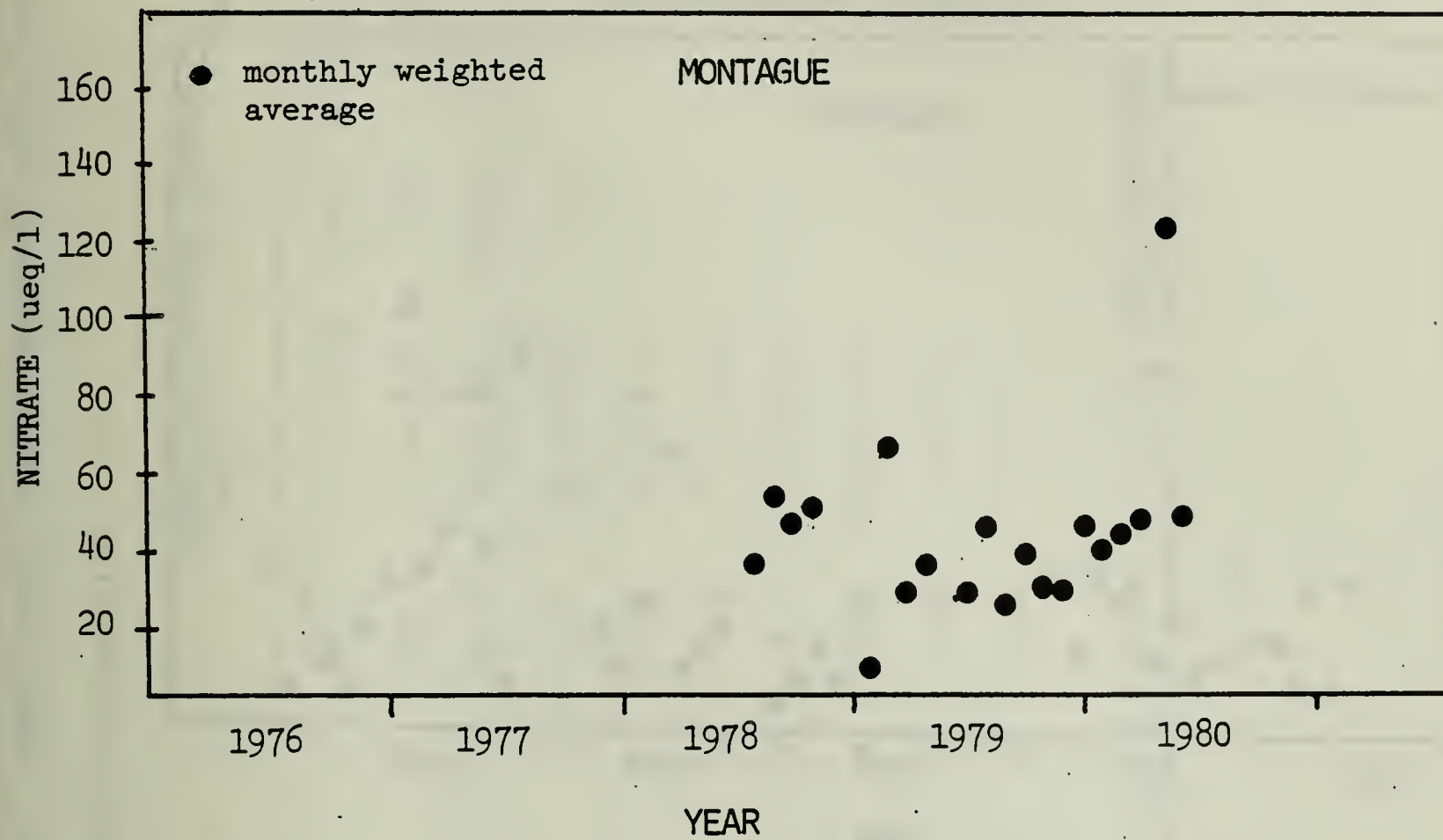
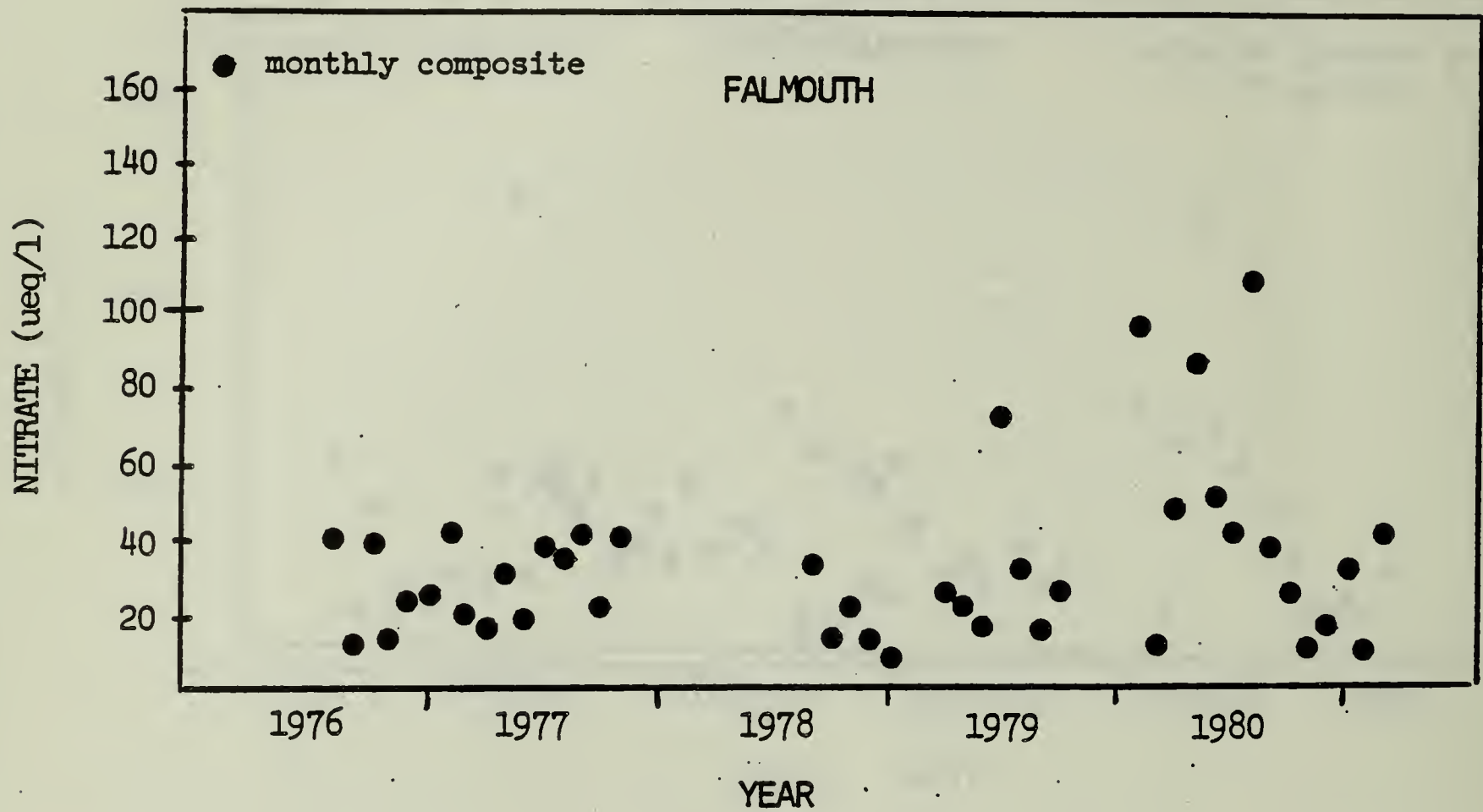


Figure 18

CHANGES IN THE CONCENTRATION OF NITRATE (UEQ/L) IN PRECIPITATION COLLECTED BY THE DEPARTMENT OF ENERGY AT THE WOODS HOLE MONITORING SITE LOCATED IN FALMOUTH, MASSACHUSETTS



SUMMARY OF HEAVY METAL DEPOSITION DATA - WOODS HOLE, MASSACHUSETTS (1977-1979)^a

Average Monthly Deposition

Precipitation (ueq/l)				Total Collector (ueq/m ²)						
n	x	Range	S.D.	Var	n	x	Range	S.D.	Var	
Al	5	1.80	0.56-2.95	1.07	0.915	9	381	55.7-1170	344	1.055 x 10 ⁵
Fe	5	0.48	0.16-0.76	0.24	0.0495	9	107	6.4-316	118	12382
Pb	5	0.12	0.08-0.18	0.047	0.00182	9	25.4	4.4-80.7	25.5	576.2
V	5	1.35	1.18-1.47	-----	-----	9	75.2	26.4-187	-----	-----
Mn	5	0.05	0.02-0.07	0.019	0.00038	9	11.9	0.7-21.4	-----	-----
Ni	5	0.08	0.04-0.14	-----	-----	9	6.2	1.1-19.5	-----	-----
Cr	5	0.16	0.14-0.17	-----	-----	9	8.7	1.8-22.0	-----	-----
Zn	5	1.14	0.72-1.25	-----	-----	9	139	21.0-274	-----	-----
As	5	0.13	0.13	-----	-----	9	6.8	1.0-19.1	-----	-----
Cd	5	0.004	0.00-0.01	-----	-----	9	0.4	0.1-1.1	-----	-----

^aRaw data presented in the January 1, 1980 appendix to the Environmental Quarterly of the Environmental Measurements Laboratory of the Department of Energy. EML - 370. 361 pages.

TABLE 19

SUMMARY OF HEAVY METAL DEPOSITION DATA - WOODS HOLE, MASSACHUSETTS (1977-1979)^a

Average Monthly Deposition

Precipitation (ueq/l)				Total Collector (ueq/m ²)						
n	x	Range	S.D.	Var	n	x	Range	S.D.	Var	
Al	5	1.80	0.56-2.95	1.07	0.915	9	381	55.7-1170	344	1.055 x 10 ⁵
Fe	5	0.48	0.16-0.76	0.24	0.0495	9	107	6.4-316	118	12382
Pb	5	0.12	0.08-0.18	0.047	0.00182	9	25.4	4.4-80.7	25.5	576.2
V	5	1.35	1.18-1.47	----	-----	9	75.2	26.4-187	----	-----
Mn	5	0.05	0.02-0.07	0.019	0.00038	9	11.9	0.7-21.4	----	-----
Ni	5	0.08	0.04-0.14	----	-----	9	6.2	1.1-19.5	----	-----
Cr	5	0.16	0.14-0.17	----	-----	9	8.7	1.8-22.0	----	-----
Zn	5	1.14	0.72-1.25	----	-----	9	139	21.0-274	----	-----
As	5	0.13	0.13	----	-----	9	6.8	1.0-19.1	----	-----
Cd	5	0.004	0.00-0.01	----	-----	9	0.4	0.1-1.1	----	-----

^aRaw data presented in the January 1, 1980 appendix to the Environmental Quarterly of the Environmental Measurements Laboratory of the Department of Energy. EML - 370. 361 pages.

TABLE 20

Average monthly deposition (dry and wet precipitation) of heavy metals at Woods Hole, Falmouth, Massachusetts (June 1977 - April 1979).*

	ueq/m ² -month	g/hectare-month	(range)
Al	381	34.3	(5.01 - 105)
Fe	107	19.9	(1.19 - 58.8)
Pb	25.4	26.3	(4.55 - 83.6)
V	74.6	7.61	(2.69 - 19.1)
Mn	11.9	3.27	(0.30 - 5.88)
Ni	6.2	1.82	(0.32 - 5.72)
Cr	8.1	1.51	(0.30 - 3.81)
Zn	139	45.4	(6.86 - 91.2)
As	6.8	1.68	(0.25 - 4.73)
Cd	0.43	0.24	(0.06 - 0.56)

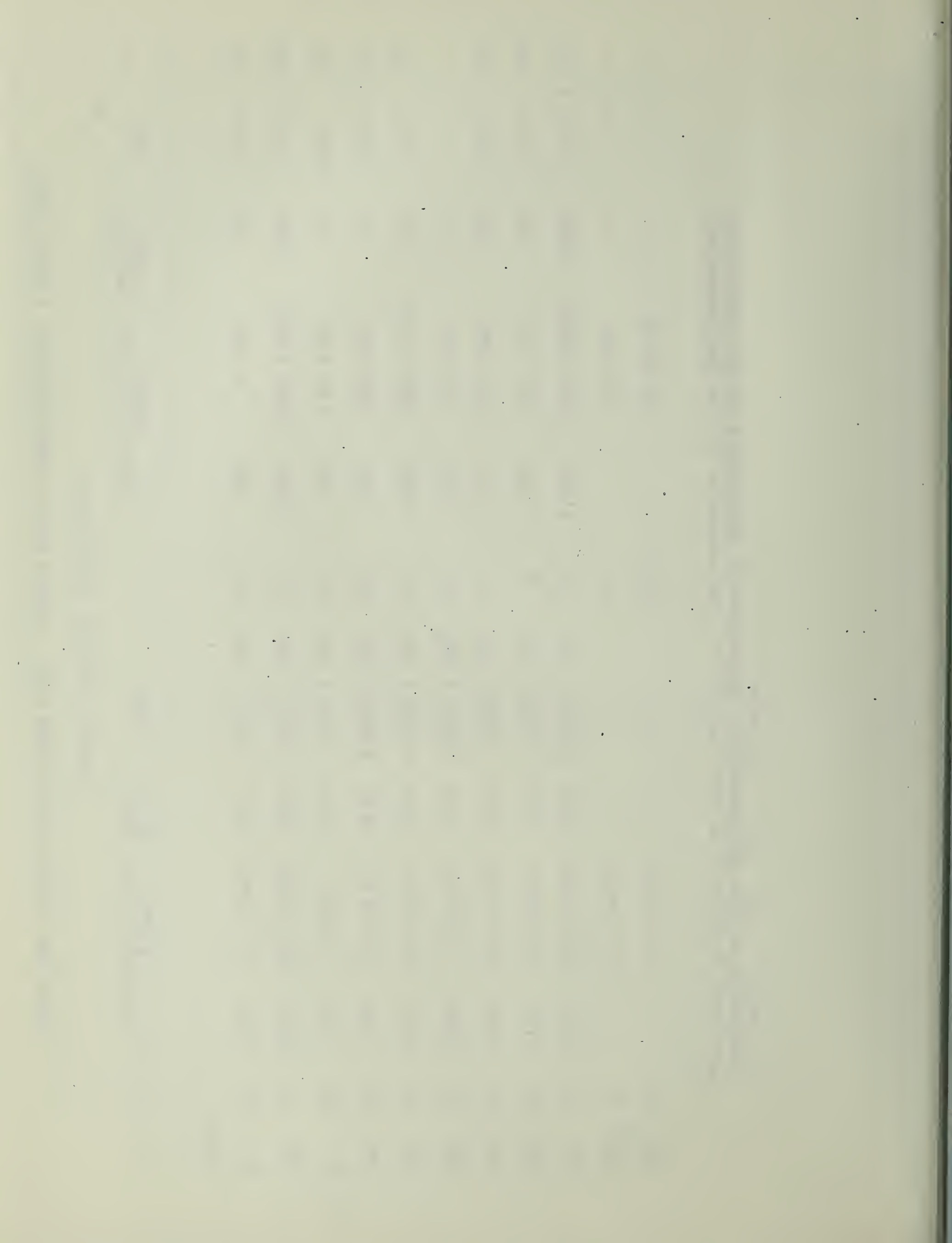
*Data were compiled by the Environmental Measurements Laboratory of the Department of Energy in their Environmental Quarterly, January 1, 1980. Environmental Measurements Laboratory, U.S. Department of Energy, New York, N.Y. 10014.

ANION AND CATION DEPOSITION DATA - WOODS HOLE, MASSACHUSETTS (1976-1979)^a

Average Monthly Deposition

Cond.	Precipitation (ueq/l)			Total Collector (ueq/m ²)		
	n	x	Range	S.D.	Var	Cond.
Average Monthly Deposition						
	n	x	Range	S.D.	Var	Cond.
H	25	4900	810-20600	4710	2.133 x 10 ⁷	25
Na	25	10300	1290-26300	7390	5.242 x 10 ⁷	25
K	25	292	57-675	169	2.747 x 10 ⁴	25
Ca	25	910	270-2170	2170	2.087 x 10 ⁵	25
Mg	25	2510	320-6250	1700	2.766 x 10 ⁶	25
NH ₄	25	1650	65-2140	1710	2.811 x 10 ⁶	25
SO ₄	25	5490	1650-13600	3300	1.048 x 10 ⁷	25
NO ₃	25	2107	759-6240	1260	1.520 x 10 ⁷	25
Cl	25	11200	1220-32000	8330	6.663 x 10 ⁷	25
HCO ₃	25		<23.0-1660	-----	-----	-----
PO ₄	25		<2.0-2790	-----	-----	-----

^aRaw data presented in the January 1, 1980 appendix to the Environmental Quarterly of the Environmental Measurements Laboratory of the Department of Energy. EML - 370. 361 pages.



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